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(54) Title: NOVEL STREPTOCOCCUS PNEUMONIAE OPEN READING FRAMES ENCODING POLYPEPTIDE ANTIGENS AND USES THEREOF

(57) **Abstract:** The present invention relates to newly identified open reading frames comprised within the genomic nucleotide sequence of *Streptococcus pneumoniae*, wherein the open reading frames encode polypeptides that are surface localized on *Streptococcus pneumoniae*. Thus, the invention relates to *Streptococcus pneumoniae* open reading frames that encode polypeptide antigens, polypeptides, preferably antigenic polypeptides, encoded by the *Streptococcus pneumoniae* open reading frames, vectors comprising open reading frame sequences and cells or animals transformed with these vectors. The invention relates also to methods of detecting these nucleic acids or polypeptides and kits for diagnosing *Streptococcus pneumoniae* infection. The invention finally relates to pharmaceutical compositions, in particular immunogenic compositions, for the prevention and/or treatment of bacterial infection, in particular infections with *Streptococcus pneumoniae*. In particular embodiments, the immunogenic compositions are used for the treatment or prevention of systemic diseases which are induced or exacerbated by *Streptococcus pneumoniae*. In other embodiments, the immunogenic compositions are used for the treatment or prevention of non-systemic diseases, particularly of the otitis media, which are induced or exacerbated by *Streptococcus pneumoniae*.

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NOVEL *STREPTOCOCCUS PNEUMONIAE* OPEN READING FRAMES ENCODING POLYPEPTIDE ANTIGENS AND USES THEREOF

This application claims priority from copending provisional application serial number 60/283,948, filed on April 16, 2001, the entire disclosure of which is hereby incorporated by reference and provisional application serial number 60/284,443, filed April 18, 2001, the entire disclosure of which is hereby incorporated by reference.

FIELD OF THE INVENTION

The invention relates to *Streptococcus pneumoniae* genomic sequence and polynucleotide sequences encoding polypeptides of *Streptococcus pneumoniae*. More particularly, the invention relates to newly identified polynucleotide open reading frames comprised within the genomic nucleotide sequence of *Streptococcus pneumoniae*, wherein the open reading frames encode *Streptococcus pneumoniae* polypeptides, preferably polypeptides that are surface localized, secreted, membrane associated or exposed on *Streptococcus pneumoniae*.

BACKGROUND OF THE INVENTION

Streptococcus pneumoniae infections are a major cause of human diseases such as otitis media, bacteremia, meningitis, septic arthritis and fatal pneumonia worldwide (Butler *et al.*, 1999; James and Thomas, 2000). Over the past 10-20 years, *Streptococcus pneumoniae* has developed resistance to most antibiotics used for its treatment. In fact, it is common for *Streptococcus pneumoniae* to become resistant to more than one class of antibiotic, *e.g.*, β-lactams, macrolides, lincosamides, trimethoprim-sulfamethoxazole, tetracyclines (Tauber, 2000), meaning *Streptococcus pneumoniae* treatment is becoming more difficult.

Thus, the rapid emergence of multi-drug resistant pneumococcal strains throughout the world has led to increased emphasis on prevention of pneumococcal

infections by immunization (Goldstein and Garau, 1997). The currently available 23-valent pneumococcal capsular polysaccharide vaccine, is not effective in children of less than 2 years of age or in immunocompromised patients, two of the major populations at risk from pneumococcal infection (Douglas *et al.*, 1983). A 7-valent pneumococcal polysaccharide-protein conjugate vaccine, recently licensed in the United States, was shown to be highly effective in infants and children against systemic pneumococcal disease caused by the vaccine serotypes and against cross-reactive capsular serotypes (Shinefield and Black, 2000). The seven capsular types cover greater than 80% of the invasive disease isolates in children in the United States, but only 57-60% of disease isolates in other areas of the world (Hausdorff *et al.*, 2000). There is therefore an immediate need for a cost-effective vaccine to cover most or all of the disease causing serotypes of pneumococci. While this can be achieved by adding conjugates covering additional serotypes, efforts continue to find non-capsular vaccine antigens that are conserved among all pneumococcal serotypes and effective against pneumococcal disease.

Protein antigens of *Streptococcus pneumoniae* have been evaluated for protective efficacy in animal models of pneumococcal infection. Some of the most commonly studied candidate antigens include the PspA proteins, PsaA lipoprotein, and the CbpA protein. Numerous studies have shown that PspA protein is a virulence factor (Crain *et al.*, 1990; McDaniel *et al.*, 1984) but it is antigenically variable among pneumococcal strains. A recent study has indicated that some antigenically conserved regions of a recombinant PspA variant may elicit cross-reactive antibodies in human adults (Nabors *et al.*, 2000). PsaA, a 37 kD lipoprotein with similarity to other gram-positive adhesins, is involved in Mn^{+} transport in pneumococci (Sampson *et al.*, 1994; Dintilhac *et al.*, 1997) and has also been shown to be protective in mouse models of systemic disease (Talkington *et al.*, 1996). The surface exposed choline binding protein CbpA is antigenically conserved and protective in mouse models of pneumococcal disease (Rosenow *et al.*, 1997). Since nasopharyngeal colonization is a prerequisite for otic disease, intranasal immunization of mice with pneumococcal proteins and appropriate mucosal adjuvants has been used to enhance the mucosal antibody response and thus, the effectiveness of candidate antigens (Yamamoto *et al.*, 1998; Briles *et al.*, 2000).

While the PspA protein, PsaA lipoprotein and the CbpA protein antigens appear promising, it is possible that no one protein antigen will be effective against all *Streptococcus pneumoniae* serotypes. Laboratories therefore continue to search for additional candidates that are antigenically conserved and elicit antibodies that reduce colonization (important for otitis media), are protective against systemic disease, or both. Thus, there is an immediate need for a cost-effective vaccine to cover most or all of the disease causing serotypes of *Streptococcus pneumoniae* and methods of diagnosing *Streptococcus pneumoniae* infection. A better understanding of the genetic and molecular levels of *Streptococcus pneumoniae* infection will provide the basis for further development of preventative treatments, therapeutic treatments, new diagnostics and vaccine strategies which are specific for *Streptococcus pneumoniae.*

SUMMARY OF THE INVENTION

The present invention broadly relates to *Streptococcus pneumoniae* genomic sequence. More particularly, the invention relates to newly identified polynucleotide open reading frames comprised within the genomic nucleotide sequence of *Streptococcus pneumoniae*, wherein the open reading frames encode polypeptides that are surface localized, membrane associated, secreted, or exposed on *Streptococcus pneumoniae*.

Thus, in certain aspects, the invention relates to *Streptococcus pneumoniae* open reading frames that encode *Streptococcus pneumoniae* polypeptides. In preferred embodiments, these *Streptococcus pneumoniae* polypeptides are antigenic polypeptides. As defined hereinafter, a *Streptococcus pneumoniae* antigenic polypeptide, antigen or immunogen, is a *Streptococcus pneumoniae* polypeptide that is immunoreactive with an antibody or is a *Streptococcus pneumoniae* polypeptide that elicits an immune response. In other embodiments, the invention relates to the polynucleotides encoding these antigenic polypeptides. In other aspects, the invention relates to vectors comprising open reading frame sequences and cells or animals transformed, transfected or infected with these vectors. The invention relates also to methods of detecting these nucleic acids or polypeptides and kits for diagnosing *Streptococcus pneumoniae* infection. The invention further relates to pharmaceutical compositions, in particular immunogenic compositions, for the

prevention and/or treatment of bacterial infection, in particular infections with *Streptococcus pneumoniae*. In a preferred embodiment, the immunogenic compositions are used for the treatment or prevention of systemic diseases that are induced or worsened by *Streptococcus pneumoniae*. In another preferred embodiment, the immunogenic compositions are used for the treatment or prevention of non-systemic diseases, particularly of the otitis media, which are induced or worsened by *Streptococcus pneumoniae*.

In particular embodiments, an isolated polynucleotide of the present invention is a polynucleotide comprising a nucleotide sequence having at least about 95% identity to a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO:431 through SEQ ID NO:591, a degenerate variant thereof, or a fragment thereof. As defined hereinafter, a "degenerate variant" is defined as a polynucleotide that differs from the nucleotide sequence shown in SEQ ID NO:1 through SEQ ID NO:215 and SEQ ID NO:431 through SEQ ID NO:591 (and fragments thereof) due to degeneracy of the genetic code, but still encodes the same *Streptococcus pneumoniae* polypeptide (*i.e.*, SEQ ID NO:216 through SEQ ID NO:430 and SEQ ID NO:592 through SEQ ID NO:752) as that encoded by the nucleotide sequence shown in SEQ ID NO:1 through SEQ ID NO:215 and SEQ ID NO:431 through SEQ ID NO:591.

In other embodiments, the polynucleotide is a complement to a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO:431 through SEQ ID NO:591, a degenerate variant thereof, or a fragment thereof. In yet other embodiments, the polynucleotide is selected from the group consisting of DNA, chromosomal DNA, cDNA and RNA and may further comprise heterologous nucleotides.

In another embodiment, the invention comprises an isolated polynucleotide that hybridizes to a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO:431 through SEQ ID NO:591, a complement thereof, a degenerate variant thereof, or a fragment thereof, under high stringency hybridization conditions. In yet other embodiments, the polynucleotide hybridizes under intermediate stringency hybridization conditions.

In a preferred embodiment, an isolated polynucleotide of a *Streptococcus pneumoniae* genomic sequence comprises a nucleotide sequence chosen from one

of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO:431 through SEQ ID NO:591, a fragment thereof, or a degenerate variant thereof, and encodes a polypeptide, a biological equivalent thereof, or a fragment thereof, selected from the group consisting of a *Streptococcus pneumoniae* polypeptide having 0, 1 or 2 transmembrane domains, a *Streptococcus pneumoniae* polypeptide having 3 or more transmembrane domains, a *Streptococcus pneumoniae* polypeptide having an outer membrane domain or a periplasmic domain, a *Streptococcus pneumoniae* polypeptide having an inner membrane domain, a *Streptococcus pneumoniae* polypeptide identified by Blastp analysis, a *Streptococcus pneumoniae* polypeptide identified by Pfam analysis, a *Streptococcus pneumoniae* lipoprotein, a *Streptococcus pneumoniae* polypeptide having a LPXTG motif, wherein the polypeptide is covalently attached to the peptidoglycan layer, a *Streptococcus pneumoniae* polypeptide having a peptidoglycan binding motif, wherein the polypeptide is associated with the peptidoglycan layer, a *Streptococcus pneumoniae* polypeptide having a signal sequence and a C-terminal Tyrosine or Phenylalanine amino acid, a *Streptococcus pneumoniae* polypeptide having a tripeptide RGD sequence, a *Streptococcus pneumoniae* polypeptide identified by proteomics as surface exposed and a *Streptococcus pneumoniae* polypeptide identified by proteomics as membrane associated.

In other embodiments, the isolated polynucleotide is a complement to a *Streptococcus pneumoniae* genomic sequence comprising a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO:431 through SEQ ID NO:591, a fragment thereof, or a degenerate variant thereof, and encodes a polypeptide, a biological equivalent thereof, or a fragment thereof, selected from the group consisting of a *Streptococcus pneumoniae* polypeptide having 0, 1 or 2 transmembrane domains, a *Streptococcus pneumoniae* polypeptide having 3 or more transmembrane domains, a *Streptococcus pneumoniae* polypeptide having an outer membrane domain or a periplasmic domain, a *Streptococcus pneumoniae* polypeptide having an inner membrane domain, a *Streptococcus pneumoniae* polypeptide identified by Blastp analysis, a *Streptococcus pneumoniae* polypeptide identified by Pfam analysis, a *Streptococcus pneumoniae* lipoprotein, a *Streptococcus pneumoniae* polypeptide having a LPXTG motif, wherein the polypeptide is covalently attached to the peptidoglycan layer, a *Streptococcus*

pneumoniae polypeptide having a peptidoglycan binding motif, wherein the polypeptide is associated with the peptidoglycan layer, a *Streptococcus pneumoniae* polypeptide having a signal sequence and a C-terminal Tyrosine or Phenylalanine amino acid, a *Streptococcus pneumoniae* polypeptide having a tripeptide RGD sequence, a *Streptococcus pneumoniae* polypeptide identified by proteomics as surface exposed and a *Streptococcus pneumoniae* polypeptide identified by proteomics as membrane associated. In certain embodiments, the polynucleotide is selected from the group consisting of DNA, chromosomal DNA, cDNA and RNA and may further comprise heterologous nucleotides. In still other embodiments, the polynucleotide encodes a fusion polypeptide.

In a preferred embodiment, a polynucleotide encoding a polypeptide having 0, 1 or 2 transmembrane domains comprises a nucleotide sequence chosen from one of SEQ ID NO: 1, SEQ ID NO: 3, SEQ ID NO: 4, SEQ ID NO: 7, SEQ ID NO: 8, SEQ ID NO: 9, SEQ ID NO: 11, SEQ ID NO: 13, SEQ ID NO: 16, SEQ ID NO: 17, SEQ ID NO: 18, SEQ ID NO: 19, SEQ ID NO: 22, SEQ ID NO: 23, SEQ ID NO: 24, SEQ ID NO: 25, SEQ ID NO: 28, SEQ ID NO: 29, SEQ ID NO: 32, SEQ ID NO: 34, SEQ ID NO: 36, SEQ ID NO: 39, SEQ ID NO: 41, SEQ ID NO: 42, SEQ ID NO: 45, SEQ ID NO: 47, SEQ ID NO: 49, SEQ ID NO: 50, SEQ ID NO: 51, SEQ ID NO: 53, SEQ ID NO: 55, SEQ ID NO: 57, SEQ ID NO: 58, SEQ ID NO: 60, SEQ ID NO: 61, SEQ ID NO: 62, SEQ ID NO: 63, SEQ ID NO: 64, SEQ ID NO: 66, SEQ ID NO: 67, SEQ ID NO: 68, SEQ ID NO: 69, SEQ ID NO: 70, SEQ ID NO: 72, SEQ ID NO: 73, SEQ ID NO: 74, SEQ ID NO: 78, SEQ ID NO: 79, SEQ ID NO: 81, SEQ ID NO: 83, SEQ ID NO: 85, SEQ ID NO: 86, SEQ ID NO: 89, SEQ ID NO: 91, SEQ ID NO: 92, SEQ ID NO: 95, SEQ ID NO: 96, SEQ ID NO: 97, SEQ ID NO: 100, SEQ ID NO: 104, SEQ ID NO: 105, SEQ ID NO: 106, SEQ ID NO: 109, SEQ ID NO: 110, SEQ ID NO: 111, SEQ ID NO: 113, SEQ ID NO: 116, SEQ ID NO: 121, SEQ ID NO: 122, SEQ ID NO: 123, SEQ ID NO: 125, SEQ ID NO: 126, SEQ ID NO: 127, SEQ ID NO: 128, SEQ ID NO: 131, SEQ ID NO: 132, SEQ ID NO: 134, SEQ ID NO: 136, SEQ ID NO: 137, SEQ ID NO: 138, SEQ ID NO: 141, SEQ ID NO: 142, SEQ ID NO: 143, SEQ ID NO: 144, SEQ ID NO: 147, SEQ ID NO: 148, SEQ ID NO: 149, SEQ ID NO: 150, SEQ ID NO: 155, SEQ ID NO: 156, SEQ ID NO: 158, SEQ ID NO: 161, SEQ ID NO: 162, SEQ ID NO: 165, SEQ ID NO: 170, SEQ ID NO: 171, SEQ ID NO: 172, SEQ ID NO: 174, SEQ ID NO: 176, SEQ ID NO: 179, SEQ ID NO: 183, SEQ ID NO: 185, SEQ ID

NO: 187, SEQ ID NO: 192, SEQ ID NO: 195, SEQ ID NO: 196, SEQ ID NO: 197, SEQ ID NO: 199, SEQ ID NO: 200, SEQ ID NO: 201, SEQ ID NO: 202, SEQ ID NO: 204, SEQ ID NO: 205, SEQ ID NO: 207, SEQ ID NO: 209 and SEQ ID NO: 210.

In another preferred embodiment, a polynucleotide encoding a polypeptide having 3 or more transmembrane domains comprises a nucleotide sequence chosen from one of SEQ ID NO: 2, SEQ ID NO: 5, SEQ ID NO: 6, SEQ ID NO: 10, SEQ ID NO: 12, SEQ ID NO: 14, SEQ ID NO: 15, SEQ ID NO: 20, SEQ ID NO: 21, SEQ ID NO: 26, SEQ ID NO: 27, SEQ ID NO: 30, SEQ ID NO: 31, SEQ ID NO: 33, SEQ ID NO: 35, SEQ ID NO: 37, SEQ ID NO: 38, SEQ ID NO: 40, SEQ ID NO: 43, SEQ ID NO: 44, SEQ ID NO: 46, SEQ ID NO: 48, SEQ ID NO: 52, SEQ ID NO: 54, SEQ ID NO: 56, SEQ ID NO: 59, SEQ ID NO: 65, SEQ ID NO: 71, SEQ ID NO: 75, SEQ ID NO: 76, SEQ ID NO: 77, SEQ ID NO: 80, SEQ ID NO: 82, SEQ ID NO: 84, SEQ ID NO: 87, SEQ ID NO: 88, SEQ ID NO: 90, SEQ ID NO: 93, SEQ ID NO: 94, SEQ ID NO: 98, SEQ ID NO: 99, SEQ ID NO: 101, SEQ ID NO: 102, SEQ ID NO: 103, SEQ ID NO: 107, SEQ ID NO: 108, SEQ ID NO: 112, SEQ ID NO: 114, SEQ ID NO: 115, SEQ ID NO: 117, SEQ ID NO: 118, SEQ ID NO: 119, SEQ ID NO: 120, SEQ ID NO: 124, SEQ ID NO: 129, SEQ ID NO: 130, SEQ ID NO: 133, SEQ ID NO: 135, SEQ ID NO: 139, SEQ ID NO: 140, SEQ ID NO: 145, SEQ ID NO: 146, SEQ ID NO: 151, SEQ ID NO: 152, SEQ ID NO: 153, SEQ ID NO: 154, SEQ ID NO: 157, SEQ ID NO: 159, SEQ ID NO: 160, SEQ ID NO: 163, SEQ ID NO: 164, SEQ ID NO: 166, SEQ ID NO: 167, SEQ ID NO: 168, SEQ ID NO: 169, SEQ ID NO: 173, SEQ ID NO: 175, SEQ ID NO: 177, SEQ ID NO: 178, SEQ ID NO: 180, SEQ ID NO: 181, SEQ ID NO: 182, SEQ ID NO: 184, SEQ ID NO: 186, SEQ ID NO: 188, SEQ ID NO: 189, SEQ ID NO: 190, SEQ ID NO: 191, SEQ ID NO: 193, SEQ ID NO: 194, SEQ ID NO: 198, SEQ ID NO: 203, SEQ ID NO: 206, SEQ ID NO: 208, SEQ ID NO: 211, SEQ ID NO: 212, SEQ ID NO: 213, SEQ ID NO: 214 and SEQ ID NO: 215.

In other preferred embodiments, a polynucleotide encoding a polypeptide having an outer membrane domain or a periplasmic domain comprises a nucleotide sequence chosen from one of SEQ ID NO: 3, SEQ ID NO: 8, SEQ ID NO: 9, SEQ ID NO: 23, SEQ ID NO: 39, SEQ ID NO: 50, SEQ ID NO: 62, SEQ ID NO: 67, SEQ ID NO: 78, SEQ ID NO: 85, SEQ ID NO: 125, SEQ ID NO: 134, SEQ ID NO: 147, SEQ ID NO: 165, SEQ ID NO: 172 and SEQ ID NO: 179.

In other preferred embodiments, a polynucleotide encoding a polypeptide having an inner membrane domain comprises a nucleotide sequence chosen from one of SEQ ID NO: 2, SEQ ID NO: 5, SEQ ID NO: 6, SEQ ID NO: 7, SEQ ID NO: 10, SEQ ID NO: 11, SEQ ID NO: 12, SEQ ID NO: 13, SEQ ID NO: 14, SEQ ID NO: 15, SEQ ID NO: 16, SEQ ID NO: 17, SEQ ID NO: 19, SEQ ID NO: 20, SEQ ID NO: 21, SEQ ID NO: 22, SEQ ID NO: 26, SEQ ID NO: 27, SEQ ID NO: 28, SEQ ID NO: 29, SEQ ID NO: 30, SEQ ID NO: 31, SEQ ID NO: 32, SEQ ID NO: 33, SEQ ID NO: 34, SEQ ID NO: 35, SEQ ID NO: 36, SEQ ID NO: 37, SEQ ID NO: 38, SEQ ID NO: 40, SEQ ID NO: 43, SEQ ID NO: 44, SEQ ID NO: 46, SEQ ID NO: 47, SEQ ID NO: 48, SEQ ID NO: 51, SEQ ID NO: 52, SEQ ID NO: 53, SEQ ID NO: 54, SEQ ID NO: 56, SEQ ID NO: 59, SEQ ID NO: 60, SEQ ID NO: 61, SEQ ID NO: 65, SEQ ID NO: 68, SEQ ID NO: 69, SEQ ID NO: 70, SEQ ID NO: 71, SEQ ID NO: 73, SEQ ID NO: 75, SEQ ID NO: 76, SEQ ID NO: 77, SEQ ID NO: 79, SEQ ID NO: 80, SEQ ID NO: 81, SEQ ID NO: 82, SEQ ID NO: 83, SEQ ID NO: 84, SEQ ID NO: 86 SEQ ID NO: 87, SEQ ID NO: 88, SEQ ID NO: 90, SEQ ID NO: 91, SEQ ID NO: 93, SEQ ID NO: 94, SEQ ID NO: 95, SEQ ID NO: 96, SEQ ID NO: 97, SEQ ID NO: 98, SEQ ID NO: 99, SEQ ID NO: 100, SEQ ID NO: 101, SEQ ID NO: 102, SEQ ID NO: 103, SEQ ID NO: 105, SEQ ID NO: 106, SEQ ID NO: 107, SEQ ID NO: 108, SEQ ID NO: 109, SEQ ID NO: 112, SEQ ID NO: 113, SEQ ID NO: 114, SEQ ID NO: 115, SEQ ID NO: 117, SEQ ID NO: 118, SEQ ID NO: 119, SEQ ID NO: 120, SEQ ID NO: 121, SEQ ID NO: 122, SEQ ID NO: 123, SEQ ID NO: 124, SEQ ID NO: 126, SEQ ID NO: 127, SEQ ID NO: 128, SEQ ID NO: 129, SEQ ID NO: 130, SEQ ID NO: 131, SEQ ID NO: 132, SEQ ID NO: 133, SEQ ID NO: 135, SEQ ID NO: 136, SEQ ID NO: 139, SEQ ID NO: 140, SEQ ID NO: 141, SEQ ID NO: 142, SEQ ID NO: 144, SEQ ID NO: 145, SEQ ID NO: 146, SEQ ID NO: 148, SEQ ID NO: 150, SEQ ID NO: 151, SEQ ID NO: 152, SEQ ID NO: 153, SEQ ID NO: 154, SEQ ID NO: 156, SEQ ID NO: 157, SEQ ID NO: 158, SEQ ID NO: 159, SEQ ID NO: 160, SEQ ID NO: 162, SEQ ID NO: 163, SEQ ID NO: 164, SEQ ID NO: 166, SEQ ID NO: 167, SEQ ID NO: 168, SEQ ID NO: 169, SEQ ID NO: 170, SEQ ID NO: 173, SEQ ID NO: 175, SEQ ID NO: 176, SEQ ID NO: 177, SEQ ID NO: 178, SEQ ID NO: 180, SEQ ID NO: 181, SEQ ID NO: 182, SEQ ID NO: 184, SEQ ID NO: 186, SEQ ID NO: 187, SEQ ID NO: 188, SEQ ID NO: 189, SEQ ID NO: 190, SEQ ID NO: 191, SEQ ID NO: 192, SEQ ID NO: 193, SEQ ID NO: 194, SEQ ID NO: 195, SEQ ID NO: 198, SEQ ID NO: 200, SEQ ID NO: 203, SEQ ID

NO: 206, SEQ ID NO: 208, SEQ ID NO: 209, SEQ ID NO: 211, SEQ ID NO: 212, SEQ ID NO: 213, SEQ ID NO: 214 and SEQ ID NO: 215.

In yet another preferred embodiment, a polynucleotide encoding a polypeptide identified by Blastp analysis comprises a nucleotide sequence chosen from one of SEQ ID NO: 1, SEQ ID NO: 2, SEQ ID NO: 7, SEQ ID NO: 10, SEQ ID NO: 12, SEQ ID NO: 16, SEQ ID NO: 20, SEQ ID NO: 24, SEQ ID NO: 27, SEQ ID NO: 30, SEQ ID NO: 31, SEQ ID NO: 32, SEQ ID NO: 33, SEQ ID NO: 34, SEQ ID NO: 35, SEQ ID NO: 38, SEQ ID NO: 40, SEQ ID NO: 42, SEQ ID NO: 43, SEQ ID NO: 44, SEQ ID NO: 48, SEQ ID NO: 51, SEQ ID NO: 53, SEQ ID NO: 59, SEQ ID NO: 60, SEQ ID NO: 61, SEQ ID NO: 65, SEQ ID NO: 67, SEQ ID NO: 68, SEQ ID NO: 69, SEQ ID NO: 70, SEQ ID NO: 71, SEQ ID NO: 75, SEQ ID NO: 76, SEQ ID NO: 77, SEQ ID NO: 78, SEQ ID NO: 79, SEQ ID NO: 80, SEQ ID NO: 87, SEQ ID NO: 88, SEQ ID NO: 90, SEQ ID NO: 94, SEQ ID NO: 95, SEQ ID NO: 96, SEQ ID NO: 98, SEQ ID NO: 100, SEQ ID NO: 103, SEQ ID NO: 105, SEQ ID NO: 107, SEQ ID NO: 108, SEQ ID NO: 109, SEQ ID NO: 112, SEQ ID NO: 113, SEQ ID NO: 115, SEQ ID NO: 117, SEQ ID NO: 118, SEQ ID NO: 122, SEQ ID NO: 123, SEQ ID NO: 124, SEQ ID NO: 127, SEQ ID NO: 129, SEQ ID NO: 131, SEQ ID NO: 132, SEQ ID NO: 133, SEQ ID NO: 134, SEQ ID NO: 135, SEQ ID NO: 136, SEQ ID NO: 138, SEQ ID NO: 139, SEQ ID NO: 141, SEQ ID NO: 144, SEQ ID NO: 146, SEQ ID NO: 147, SEQ ID NO: 151 , SEQ ID NO: 152, SEQ ID NO: 154, SEQ ID NO: 155, SEQ ID NO: 157, SEQ ID NO: 158, SEQ ID NO: 159, SEQ ID NO: 160, SEQ ID NO: 161, SEQ ID NO: 162, SEQ ID NO: 163, SEQ ID NO: 165, SEQ ID NO: 166, SEQ ID NO: 167, SEQ ID NO: 169, SEQ ID NO: 172, SEQ ID NO: 173, SEQ ID NO: 176, SEQ ID NO: 177, SEQ ID NO: 178, SEQ ID NO: 180, SEQ ID NO: 181, SEQ ID NO: 182, SEQ ID NO: 184, SEQ ID NO: 185, SEQ ID NO: 186, SEQ ID NO: 188, SEQ ID NO: 189, SEQ ID NO: 191, SEQ ID NO: 193, SEQ ID NO: 196, SEQ ID NO: 197, SEQ ID NO: 198, SEQ ID NO: 199, SEQ ID NO: 200, SEQ ID NO: 201, SEQ ID NO: 202, SEQ ID NO: 204, SEQ ID NO: 205, SEQ ID NO: 206, SEQ ID NO: 207, SEQ ID NO: 208, SEQ ID NO: 210, SEQ ID NO: 212, SEQ ID NO: 213 and SEQ ID NO: 214.

In still further preferred embodiments, a polynucleotide encoding a polypeptide identified by Pfam analysis comprises a nucleotide sequence chosen from one of SEQ ID NO: 4, SEQ ID NO: 18, SEQ ID NO: 19, SEQ ID NO: 41, SEQ ID NO: 45, SEQ ID NO: 55, SEQ ID NO: 57, SEQ ID NO: 58, SEQ ID NO: 63, SEQ ID

NO: 64, SEQ ID NO: 66, SEQ ID NO: 72, SEQ ID NO: 74, SEQ ID NO: 89, SEQ ID NO: 92, SEQ ID NO: 104, SEQ ID NO: 111, SEQ ID NO: 116, SEQ ID NO: 119, SEQ ID NO: 128, SEQ ID NO: 137, SEQ ID NO: 142, SEQ ID NO: 143, SEQ ID NO: 149, SEQ ID NO: 151, SEQ ID NO: 152, SEQ ID NO: 153, SEQ ID NO: 157, SEQ ID NO: 159, SEQ ID NO: 160, SEQ ID NO: 162, SEQ ID NO: 163, SEQ ID NO: 164, SEQ ID NO: 165, SEQ ID NO: 166, SEQ ID NO: 169, SEQ ID NO: 171, SEQ ID NO: 174, SEQ ID NO: 176, SEQ ID NO: 180, SEQ ID NO: 182, SEQ ID NO: 183, SEQ ID NO: 184, SEQ ID NO: 186, SEQ ID NO: 188, SEQ ID NO 189, SEQ ID NO: 195, SEQ ID NO: 198, SEQ ID NO 199, SEQ ID NO: 205, SEQ ID NO: 212 and SEQ ID NO: 213.

In another preferred embodiment, a polynucleotide encoding a lipoprotein comprises a nucleotide sequence chosen from one of SEQ ID NO: 3, SEQ ID NO: 8, SEQ ID NO: 9, SEQ ID NO: 13, SEQ ID NO: 21, SEQ ID NO: 26, SEQ ID NO: 34, SEQ ID NO: 62, SEQ ID NO: 67, SEQ ID NO: 85, SEQ ID NO: 134, SEQ ID NO: 147, SEQ ID NO: 150, SEQ ID NO: 168, SEQ ID NO: 170 and SEQ ID NO: 173.

In other preferred embodiments, a polynucleotide encoding a polypeptide having a LPXTG motif and is covalently attached to the peptidoglycan layer comprises a nucleotide sequence chosen from one of SEQ ID NO: 13, SEQ ID NO: 21, SEQ ID NO: 34 and SEQ ID NO: 170; or a polynucleotide encoding a polypeptide having a peptidoglycan binding motif and associated with the peptidoglycan layer comprises a nucleotide sequence chosen from one of SEQ ID NO: 25, SEQ ID NO: 49 and SEQ ID NO: 110.

In another preferred embodiment, a polynucleotide encoding a polypeptide having a signal sequence and a C-terminal Tyrosine or Phenylalanine amino acid comprises a nucleotide sequence chosen from one of SEQ ID NO:11, SEQ ID NO:39, SEQ ID NO:73, SEQ ID NO:97, SEQ ID NO:106, SEQ ID NO: 125 and SEQ ID NO:187.

In yet another preferred embodiment, a polynucleotide encoding a polypeptide having a tripeptide RGD sequence that potentially is involved in cell attachment comprises a nucleotide sequence chosen from one of SEQ ID NO:1, SEQ ID NO:21, SEQ ID NO:66 and SEQ ID NO:67.

In another preferred embodiment, a polynucleotide encoding a polypeptide identified by proteomics as surface exposed comprises a nucleotide sequence chosen from one of SEQ ID NO:14, SEQ ID NO:16, SEQ ID NO:17, SEQ ID NO:46,

SEQ ID NO:64, SEQ ID NO:66, SEQ ID NO:67, SEQ ID NO:69, SEQ ID NO:71, SEQ ID NO:74, SEQ ID NO:91, SEQ ID NO:103, SEQ ID NO:116, SEQ ID NO:128, SEQ ID NO:131, SEQ ID NO:136, SEQ ID NO:151, SEQ ID NO:156, SEQ ID NO:159, SEQ ID NO:162, SEQ ID NO:164, SEQ ID NO:172, SEQ ID NO:176, SEQ ID NO:178, SEQ ID NO:179, SEQ ID NO:180, SEQ ID NO:182 and SEQ ID NO:205.

In still another embodiment, a polynucleotide encoding a polypeptide identified by proteomics as membrane associated comprises a nucleotide sequence chosen from one of SEQ ID NO:431 through SEQ ID NO:591.

In certain aspects, the invention relates to *Streptococcus pneumoniae* polypeptides. More particularly, the invention relates to *Streptococcus pneumoniae* polypeptides, more preferably antigenic polypeptides, encoded by *Streptococcus pneumoniae* polynucleotide open reading frames. Thus, in certain embodiments, an isolated polypeptide is encoded by a polynucleotide comprising a nucleotide sequence having at least about 95% identity to a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591, a degenerate variant thereof, or a fragment thereof. In a preferred embodiment, the isolated polypeptide encoded by one of the above polynucleotides comprises an amino acid sequence having at least about 95% identity to an amino acid sequence chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof. In other embodiments, the polypeptide is a fusion polypeptide. In a preferred embodiment, the polypeptide immunoreacts with seropositive serum of an individual infected with *Streptococcus pneumoniae.*

In preferred embodiments, the isolated polypeptide encoded by a polynucleotide comprising a nucleotide sequence having at least about 95% identity to a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591, a degenerate variant thereof, or a fragment thereof, is further defined as a *Streptococcus pneumoniae* polypeptide having 0, 1 or 2 transmembrane domains, a *Streptococcus pneumoniae* polypeptide having 3 or more transmembrane domains, a *Streptococcus pneumoniae* polypeptide having an outer membrane domain or a periplasmic domain, a *Streptococcus pneumoniae* polypeptide having an inner membrane domain, a *Streptococcus pneumoniae* polypeptide identified by Blastp analysis, a *Streptococcus pneumoniae*

polypeptide identified by Pfam analysis, a *Streptococcus pneumoniae* lipoprotein, a *Streptococcus pneumoniae* polypeptide having a LPXTG motif, wherein the polypeptide is covalently attached to the peptidoglycan layer, a *Streptococcus pneumoniae* polypeptide having a peptidoglycan binding motif, wherein the polypeptide is associated with the peptidoglycan layer, a *Streptococcus pneumoniae* polypeptide having a signal sequence and a C-terminal Tyrosine or Phenylalanine amino acid, a *Streptococcus pneumoniae* polypeptide having a tripeptide RGD sequence, a *Streptococcus pneumoniae* polypeptide identified by proteomics as surface exposed or a *Streptococcus pneumoniae* polypeptide identified by proteomics as membrane associated, where each of these groups has the set of ORFs identified above as within SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591.

In a particularly preferred embodiment, an isolated polypeptide comprises an amino acid sequence having at least about 95% identity to an amino acid sequence chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof. In another embodiment, the polypeptide is a fusion polypeptide. In a particularly preferred embodiment, the polypeptide immunoreacts with seropositive serum of an individual infected with *Streptococcus pneumoniae*. In yet other preferred embodiments, the polypeptide is further defined as a *Streptococcus pneumoniae* polypeptide having 0, 1 or 2 transmembrane domains, a *Streptococcus pneumoniae* polypeptide having 3 or more transmembrane domains, a *Streptococcus pneumoniae* polypeptide having an outer membrane domain or a periplasmic domain, a *Streptococcus pneumoniae* polypeptide having an inner membrane domain, a *Streptococcus pneumoniae* polypeptide identified by Blastp analysis, a *Streptococcus pneumoniae* polypeptide identified by Pfam analysis, a *Streptococcus pneumoniae* lipoprotein, a *Streptococcus pneumoniae* polypeptide having a LPXTG motif, wherein the polypeptide is covalently attached to the peptidoglycan layer, a *Streptococcus pneumoniae* polypeptide having a peptidoglycan binding motif, wherein the polypeptide is associated with the peptidoglycan layer, a *Streptococcus pneumoniae* polypeptide having a signal sequence and a C-terminal Tyrosine or Phenylalanine amino acid, a *Streptococcus pneumoniae* polypeptide having a tripeptide RGD sequence, a *Streptococcus pneumoniae* polypeptide identified by

proteomics as surface exposed or a *Streptococcus pneumoniae* polypeptide identified by proteomics as membrane associated.

In a preferred embodiment, a polypeptide having 0, 1 or 2 transmembrane domains comprises an amino acid sequence chosen from one of SEQ ID NO: 216, SEQ ID NO: 218, SEQ ID NO: 219, SEQ ID NO: 222, SEQ ID NO: 223, SEQ ID NO: 224, SEQ ID NO: 226, SEQ ID NO: 228, SEQ ID NO: 231, SEQ ID NO: 232, SEQ ID NO: 233, SEQ ID NO: 234, SEQ ID NO: 237, SEQ ID NO: 238, SEQ ID NO: 239, SEQ ID NO: 240, SEQ ID NO: 243, SEQ ID NO: 244, SEQ ID NO: 247, SEQ ID NO: 249, SEQ ID NO: 251, SEQ ID NO: 254, SEQ ID NO: 256, SEQ ID NO: 257, SEQ ID NO: 260, SEQ ID NO: 262, SEQ ID NO: 264, SEQ ID NO: 265, SEQ ID NO: 266, SEQ ID NO: 268, SEQ ID NO: 270, SEQ ID NO: 272, SEQ ID NO: 273, SEQ ID NO: 275, SEQ ID NO: 276, SEQ ID NO: 277, SEQ ID NO: 278, SEQ ID NO: 279, SEQ ID NO: 281, SEQ ID NO: 282, SEQ ID NO: 283, SEQ ID NO: 284, SEQ ID NO: 285, SEQ ID NO: 286, SEQ ID NO: 287, SEQ ID NO: 289, SEQ ID NO: 293, SEQ ID NO: 294, SEQ ID NO: 296, SEQ ID NO: 298, SEQ ID NO: 300, SEQ ID NO: 301, SEQ ID NO: 304, SEQ ID NO: 306, SEQ ID NO: 307, SEQ ID NO: 310, SEQ ID NO: 311, SEQ ID NO: 312, SEQ ID NO: 315, SEQ ID NO: 319, SEQ ID NO: 320, SEQ ID NO: 321, SEQ ID NO: 324, SEQ ID NO: 325, SEQ ID NO: 326, SEQ ID NO: 328, SEQ ID NO: 331, SEQ ID NO: 336, SEQ ID NO: 337, SEQ ID NO: 338, SEQ ID NO: 340, SEQ ID NO: 341, SEQ ID NO: 342, SEQ ID NO: 343, SEQ ID NO: 346, SEQ ID NO: 347, SEQ ID NO: 349, SEQ ID NO: 351, SEQ ID NO: 352, SEQ ID NO: 353, SEQ ID NO: 356, SEQ ID NO: 357, SEQ ID NO: 358, SEQ ID NO: 359, SEQ ID NO: 362, SEQ ID NO: 363, SEQ ID NO: 364, SEQ ID NO: 365, SEQ ID NO: 370, SEQ ID NO: 371, SEQ ID NO: 373, SEQ ID NO: 376, SEQ ID NO: 377, SEQ ID NO: 380, SEQ ID NO: 385, SEQ ID NO: 386, SEQ ID NO: 387, SEQ ID NO: 389, SEQ ID NO: 391, SEQ ID NO: 394, SEQ ID NO: 398, SEQ ID NO: 400, SEQ ID NO: 402, SEQ ID NO: 407, SEQ ID NO: 410, SEQ ID NO: 411, SEQ ID NO: 412, SEQ ID NO: 414, SEQ ID NO: 415, SEQ ID NO: 416, SEQ ID NO: 417, SEQ ID NO: 419, SEQ ID NO: 420, SEQ ID NO: 422, SEQ ID NO: 424, SEQ ID NO: 425, a biological equivalent thereof, or a fragment thereof.

In another preferred embodiment, a polypeptide having 3 or more transmembrane domains comprises an amino acid sequence chosen from one of SEQ ID NO: 217, SEQ ID NO: 220, SEQ ID NO: 221, SEQ ID NO: 225, SEQ ID NO:

227, SEQ ID NO: 229, SEQ ID NO: 230, SEQ ID NO: 235, SEQ ID NO: 236, SEQ ID NO: 241, SEQ ID NO: 242, SEQ ID NO: 245, SEQ ID NO: 246, SEQ ID NO: 248, SEQ ID NO: 250, SEQ ID NO: 252, SEQ ID NO: 253, SEQ ID NO: 255, SEQ ID NO: 258, SEQ ID NO: 259, SEQ ID NO: 261, SEQ ID NO: 263, SEQ ID NO: 267, SEQ ID NO: 269, SEQ ID NO: 271, SEQ ID NO: 274, SEQ ID NO: 280, SEQ ID NO: 286, SEQ ID NO: 290, SEQ ID NO: 291, SEQ ID NO: 292, SEQ ID NO: 295, SEQ ID NO: 297, SEQ ID NO: 299, SEQ ID NO: 302, SEQ ID NO: 303, SEQ ID NO: 305, SEQ ID NO: 308, SEQ ID NO: 309, SEQ ID NO: 313, SEQ ID NO: 314, SEQ ID NO: 316, SEQ ID NO: 317, SEQ ID NO: 318, SEQ ID NO: 322, SEQ ID NO: 323, SEQ ID NO: 327, SEQ ID NO: 329, SEQ ID NO: 330, SEQ ID NO: 332, SEQ ID NO: 333, SEQ ID NO: 334, SEQ ID NO: 335, SEQ ID NO: 339, SEQ ID NO: 344, SEQ ID NO: 345, SEQ ID NO: 348, SEQ ID NO: 350, SEQ ID NO: 354, SEQ ID NO: 355, SEQ ID NO: 360, SEQ ID NO: 361, SEQ ID NO: 366, SEQ ID NO: 367, SEQ ID NO: 368, SEQ ID NO: 369, SEQ ID NO: 372, SEQ ID NO: 374, SEQ ID NO: 375, SEQ ID NO: 378, SEQ ID NO: 379, SEQ ID NO: 381, SEQ ID NO: 382, SEQ ID NO: 383, SEQ ID NO: 384, SEQ ID NO: 388, SEQ ID NO: 390, SEQ ID NO: 392, SEQ ID NO: 393, SEQ ID NO: 395, SEQ ID NO: 396, SEQ ID NO: 397, SEQ ID NO: 399, SEQ ID NO: 401, SEQ ID NO: 403, SEQ ID NO: 404, SEQ ID NO: 405, SEQ ID NO: 406, SEQ ID NO: 408, SEQ ID NO: 409, SEQ ID NO: 413, SEQ ID NO: 418, SEQ ID NO: 421, SEQ ID NO: 423, SEQ ID NO: 426, SEQ ID NO: 427, SEQ ID NO: 428, SEQ ID NO: 429, SEQ ID NO: 430, a biological equivalent thereof, or a fragment thereof.

In yet other preferred embodiments, a polypeptide having an outer membrane domain or a periplasmic domain comprises an amino acid sequence chosen from one of SEQ ID NO: 218, SEQ ID NO: 223, SEQ ID NO: 224, SEQ ID NO: 238, SEQ ID NO: 254, SEQ ID NO: 265, SEQ ID NO: 277, SEQ ID NO: 282, SEQ ID NO: 293, SEQ ID NO: 300, SEQ ID NO: 340, SEQ ID NO: 349, SEQ ID NO: 362, SEQ ID NO: 380, SEQ ID NO: 387, SEQ ID NO: 394, a biological equivalent thereof, or a fragment thereof.

In yet other preferred embodiments, a polynucleotide encoding a polypeptide having an inner membrane domain comprises an amino acid sequence chosen from one of SEQ ID NO: 217, SEQ ID NO: 220, SEQ ID NO: 221, SEQ ID NO: 222, SEQ ID NO: 225, SEQ ID NO: 226, SEQ ID NO: 227, SEQ ID NO: 228, SEQ ID NO: 229, SEQ ID NO: 230, SEQ ID NO: 231, SEQ ID NO: 232, SEQ ID NO: 234, SEQ ID NO:

235, SEQ ID NO: 236, SEQ ID NO: 237, SEQ ID NO: 241, SEQ ID NO: 242, SEQ ID NO: 243, SEQ ID NO: 244, SEQ ID NO: 245, SEQ ID NO: 246, SEQ ID NO: 247, SEQ ID NO: 248, SEQ ID NO: 249, SEQ ID NO: 250, SEQ ID NO: 251, SEQ ID NO: 252, SEQ ID NO: 253, SEQ ID NO: 255, SEQ ID NO: 258, SEQ ID NO: 259, SEQ ID NO: 261, SEQ ID NO: 262, SEQ ID NO: 263, SEQ ID NO: 266, SEQ ID NO: 267, SEQ ID NO: 268, SEQ ID NO: 269, SEQ ID NO: 271, SEQ ID NO: 274, SEQ ID NO: 275, SEQ ID NO: 276, SEQ ID NO: 280, SEQ ID NO: 283, SEQ ID NO: 284, SEQ ID NO: 285, SEQ ID NO: 286, SEQ ID NO: 288, SEQ ID NO: 290, SEQ ID NO: 291, SEQ ID NO: 292, SEQ ID NO: 294, SEQ ID NO: 295, SEQ ID NO: 296, SEQ ID NO: 297, SEQ ID NO: 298, SEQ ID NO: 299, SEQ ID NO: 301 SEQ ID NO: 302, SEQ ID NO: 303, SEQ ID NO: 305, SEQ ID NO: 306, SEQ ID NO: 308, SEQ ID NO: 309, SEQ ID NO: 310, SEQ ID NO: 311, SEQ ID NO: 312, SEQ ID NO: 313, SEQ ID NO: 314, SEQ ID NO: 315, SEQ ID NO: 316, SEQ ID NO: 317, SEQ ID NO: 318, SEQ ID NO: 320, SEQ ID NO: 321, SEQ ID NO: 322, SEQ ID NO: 323, SEQ ID NO: 324, SEQ ID NO: 327, SEQ ID NO: 328, SEQ ID NO: 329, SEQ ID NO: 330, SEQ ID NO: 332, SEQ ID NO: 333, SEQ ID NO: 334, SEQ ID NO: 335, SEQ ID NO: 336, SEQ ID NO: 337, SEQ ID NO: 338, SEQ ID NO: 339, SEQ ID NO: 341, SEQ ID NO: 342, SEQ ID NO: 343, SEQ ID NO: 344, SEQ ID NO: 345, SEQ ID NO: 346, SEQ ID NO: 347, SEQ ID NO: 348, SEQ ID NO: 350, SEQ ID NO: 351, SEQ ID NO: 354, SEQ ID NO: 355, SEQ ID NO: 356, SEQ ID NO: 357, SEQ ID NO: 359, SEQ ID NO: 360, SEQ ID NO: 361, SEQ ID NO: 362, SEQ ID NO: 365, SEQ ID NO: 366, SEQ ID NO: 367, SEQ ID NO: 368, SEQ ID NO: 369, SEQ ID NO: 371, SEQ ID NO: 372, SEQ ID NO: 373, SEQ ID NO: 374, SEQ ID NO: 375, SEQ ID NO: 377, SEQ ID NO: 378, SEQ ID NO: 379, SEQ ID NO: 381, SEQ ID NO: 382, SEQ ID NO: 383, SEQ ID NO: 384, SEQ ID NO: 385, SEQ ID NO: 388, SEQ ID NO: 390, SEQ ID NO: 391, SEQ ID NO: 392, SEQ ID NO: 393, SEQ ID NO: 395, SEQ ID NO: 396, SEQ ID NO: 397, SEQ ID NO: 399, SEQ ID NO: 401, SEQ ID NO: 402, SEQ ID NO: 403, SEQ ID NO: 404, SEQ ID NO: 405, SEQ ID NO: 406, SEQ ID NO: 407, SEQ ID NO: 408, SEQ ID NO: 409, SEQ ID NO: 410, SEQ ID NO: 413, SEQ ID NO: 415, SEQ ID NO: 418, SEQ ID NO: 421, SEQ ID NO: 423, SEQ ID NO: 424, SEQ ID NO: 426, SEQ ID NO: 427, SEQ ID NO: 428, SEQ ID NO: 429, SEQ ID NO: 430, a biological equivalent thereof, or a fragment thereof.

In still another preferred embodiment, a polypeptide identified by Blastp analysis comprises an amino acid sequence chosen from one of SEQ ID NO: 216, SEQ ID NO: 217, SEQ ID NO: 222, SEQ ID NO: 225, SEQ ID NO: 227, SEQ ID NO: 231, SEQ ID NO: 235, SEQ ID NO: 239, SEQ ID NO: 242, SEQ ID NO: 245, SEQ ID NO: 246, SEQ ID NO: 247, SEQ ID NO: 248, SEQ ID NO: 249, SEQ ID NO: 250, SEQ ID NO: 253, SEQ ID NO: 255, SEQ ID NO: 257, SEQ ID NO: 258, SEQ ID NO: 259, SEQ ID NO: 263, SEQ ID NO: 266, SEQ ID NO: 268, SEQ ID NO: 269, SEQ ID NO: 275, SEQ ID NO: 276, SEQ ID NO: 280, SEQ ID NO: 282, SEQ ID NO: 283, SEQ ID NO: 284, SEQ ID NO: 285, SEQ ID NO: 286, SEQ ID NO: 290, SEQ ID NO: 291, SEQ ID NO: 292, SEQ ID NO: 293, SEQ ID NO: 294, SEQ ID NO: 295, SEQ ID NO: 302, SEQ ID NO: 303, SEQ ID NO: 305, SEQ ID NO: 309, SEQ ID NO: 310, SEQ ID NO: 311, SEQ ID NO: 313, SEQ ID NO: 315, SEQ ID NO: 318, SEQ ID NO: 320, SEQ ID NO: 322, SEQ ID NO: 323, SEQ ID NO: 324, SEQ ID NO: 327, SEQ ID NO: 328, SEQ ID NO: 330, SEQ ID NO: 332, SEQ ID NO: 333, SEQ ID NO: 337, SEQ ID NO: 338, SEQ ID NO: 339, SEQ ID NO: 342, SEQ ID NO: 344, SEQ ID NO: 346, SEQ ID NO: 347, SEQ ID NO: 348, SEQ ID NO: 349, SEQ ID NO: 350, SEQ ID NO: 351, SEQ ID NO: 353, SEQ ID NO: 354, SEQ ID NO: 356, SEQ ID NO: 359, SEQ ID NO: 361, SEQ ID NO: 362, SEQ ID NO: 366 , SEQ ID NO: 367, SEQ ID NO: 369, SEQ ID NO: 370, SEQ ID NO: 372, SEQ ID NO: 373, SEQ ID NO: 374, SEQ ID NO: 375, SEQ ID NO: 376, SEQ ID NO: 377, SEQ ID NO: 378, SEQ ID NO: 380, SEQ ID NO: 381, SEQ ID NO: 382, SEQ ID NO: 384, SEQ ID NO: 387, SEQ ID NO: 388, SEQ ID NO: 391, SEQ ID NO: 392, SEQ ID NO: 393, SEQ ID NO: 395, SEQ ID NO: 396, SEQ ID NO: 397, SEQ ID NO: 399, SEQ ID NO: 400, SEQ ID NO: 401, SEQ ID NO: 403, SEQ ID NO: 404, SEQ ID NO: 406, SEQ ID NO: 408, SEQ ID NO: 411, SEQ ID NO: 412, SEQ ID NO: 413, SEQ ID NO: 414, SEQ ID NO: 415, SEQ ID NO: 416, SEQ ID NO: 417, SEQ ID NO: 419, SEQ ID NO: 420, SEQ ID NO: 421, SEQ ID NO: 422, SEQ ID NO: 423, SEQ ID NO: 425, SEQ ID NO: 427, SEQ ID NO: 428, SEQ ID NO: 429, a biological equivalent thereof, or a fragment thereof.

In other preferred embodiments, a polypeptide identified by Pfam analysis comprises an amino acid sequence chosen from one of SEQ ID NO: 219, SEQ ID NO: 233, SEQ ID NO: 234, SEQ ID NO: 255, SEQ ID NO: 260, SEQ ID NO: 270, SEQ ID NO: 272, SEQ ID NO: 273, SEQ ID NO: 278, SEQ ID NO: 279, SEQ ID NO: 281, SEQ ID NO: 287, SEQ ID NO: 289, SEQ ID NO: 304, SEQ ID NO: 307, SEQ ID

NO: 319, SEQ ID NO: 326, SEQ ID NO: 331, SEQ ID NO: 334, SEQ ID NO: 343, SEQ ID NO: 352, SEQ ID NO: 357, SEQ ID NO: 358, SEQ ID NO: 364, SEQ ID NO: 366, SEQ ID NO: 367, SEQ ID NO: 368, SEQ ID NO: 372, SEQ ID NO: 374, SEQ ID NO: 375, SEQ ID NO: 377, SEQ ID NO: 378, SEQ ID NO: 379, SEQ ID NO: 380, SEQ ID NO: 381, SEQ ID NO: 384, SEQ ID NO: 386, SEQ ID NO: 389, SEQ ID NO: 391, SEQ ID NO: 395, SEQ ID NO: 397, SEQ ID NO: 398, SEQ ID NO: 399, SEQ ID NO: 401, SEQ ID NO: 403, SEQ ID NO 404, SEQ ID NO: 410, SEQ ID NO: 413, SEQ ID NO 414, SEQ ID NO: 420, SEQ ID NO: 427, SEQ ID NO: 428, a biological equivalent thereof, or a fragment thereof.

In one preferred embodiment, a polypeptide is a lipoprotein and comprises an amino acid sequence chosen from one of SEQ ID NO: 218, SEQ ID NO: 223, SEQ ID NO: 224, SEQ ID NO: 228, SEQ ID NO: 236, SEQ ID NO: 241, SEQ ID NO: 249, SEQ ID NO: 277, SEQ ID NO: 282, SEQ ID NO: 300, SEQ ID NO: 349, SEQ ID NO: 362, SEQ ID NO: 365, SEQ ID NO: 383, SEQ ID NO: 385, SEQ ID NO: 388, a biological equivalent thereof, or a fragment thereof.

In certain other preferred embodiments, a polypeptide having a LPXTG motif and covalently attached to the peptidoglycan layer, comprises an amino acid sequence chosen from one of SEQ ID NO: 228, SEQ ID NO: 236, SEQ ID NO: 249, SEQ, SEQ ID NO: 385, a biological equivalent thereof, or a fragment thereof; or a polypeptide having a peptidoglycan binding motif and associated with the peptidoglycan layer comprises an amino acid sequence chosen from one of SEQ ID NO: 240, SEQ ID NO: 264, SEQ ID NO: 325, a biological equivalent thereof, or a fragment thereof.

In another preferred embodiment, a polypeptide having a signal sequence and a C-terminal Tyrosine or Phenylalanine amino acid comprises an amino acid sequence chosen from one of SEQ ID NO:226, SEQ ID NO:254, SEQ ID NO:289, SEQ ID NO:312, SEQ ID NO:321, SEQ ID NO: 340, SEQ ID NO:402, a biological equivalent thereof, or a fragment thereof.

In yet another preferred embodiment, a polypeptide having a tripeptide RGD sequence that potentially is involved in cell attachment comprises an amino acid sequence chosen from one of SEQ ID NO:216, SEQ ID NO:236, SEQ ID NO:281, SEQ ID NO:282, a biological equivalent thereof, or a fragment thereof.

In still another embodiment, a polypeptide identified by proteomics as surface exposed comprises an amino acid sequence chosen from one of SEQ ID NO: 229, SEQ ID NO: 231, SEQ ID NO: 232, SEQ ID NO: 261, SEQ ID NO: 279, SEQ ID NO: 281, SEQ ID NO: 282, SEQ ID NO: 284, SEQ ID NO: 286, SEQ ID NO: 289, SEQ ID NO: 306, SEQ ID NO: 318, SEQ ID NO: 331, SEQ ID NO: 343, SEQ ID NO: 346, SEQ ID NO: 351, SEQ ID NO: 366, SEQ ID NO: 371, SEQ ID NO: 374, SEQ ID NO: 377, SEQ ID NO: 379, SEQ ID NO: 387, SEQ ID NO: 391, SEQ ID NO: 393, SEQ ID NO: 394, SEQ ID NO: 395, SEQ ID NO: 397, SEQ ID NO: 420, a biological equivalent thereof, or a fragment thereof.

In yet another embodiment, a polypeptide identified by proteomics as membrane associated comprises an amino acid sequence chosen from one of SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof.

In another aspect of the invention, the polypeptides are expressed and purified in a recombinant expression system. Thus, in certain embodiments, the invention provides a recombinant expression vector comprising a nucleotide sequence having at least about 95% identity to a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591, a degenerate variant thereof, or a fragment thereof. In certain other embodiments, the polynucleotide is selected from the group consisting of DNA, chromosomal DNA, cDNA, RNA and antisense RNA. In another embodiment, the polynucleotide comprised within the vector further comprises heterologous nucleotide sequences. In other embodiments, the polynucleotide is operatively linked to one or more gene expression regulatory elements. In yet other embodiments, the polynucleotide encodes a polypeptide comprising an amino acid sequence having at least about 95% identity to an amino acid sequence chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof. In a preferred embodiment, the vector is a plasmid.

In another aspect of the invention, there is provided a genetically engineered host cell, transfected, transformed or infected with a recombinant expression vector comprising a nucleotide sequence having at least about 95% identity to a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID

NO: 431 through SEQ ID NO: 591, a degenerate variant thereof, or a fragment thereof. In a preferred embodiment, the host cell is a bacterial cell. In a further embodiment, the polynucleotide is expressed under suitable conditions to produce the encoded polypeptide, a biological equivalent thereof, or a fragment thereof, which is then recovered.

In other embodiments, the present invention provides an antibody specific for a *Streptococcus pneumoniae* polynucleotide chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591, a fragment thereof, a degenerate variant thereof, or an antibody specific for a *Streptococcus pneumoniae* polypeptide chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof. In certain embodiments, the antibody is selected from the group consisting of monoclonal, polyclonal, chimeric, humanized and single chain. In a preferred embodiment, the antibody is monoclonal. In another preferred embodiment, the antibody is humanized.

The present invention further provides pharmaceutical compositions, in particular immunogenic compositions, for the prevention and/or treatment of bacterial infection. Thus, in one embodiment an immunogenic composition is provided comprising a polypeptide having an amino acid sequence chosen from one or more of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof. In certain embodiments, the composition further comprises a pharmaceutically acceptable carrier. In yet other embodiments, the immunogenic composition further comprises one or more adjuvants. In a preferred embodiment, the polypeptide of the immunogenic composition is further defined as a *Streptococcus pneumoniae* polypeptide having 0, 1 or 2 transmembrane domains, a *Streptococcus pneumoniae* polypeptide having 3 or more transmembrane domains, a *Streptococcus pneumoniae* polypeptide having an outer membrane domain or a periplasmic domain, a *Streptococcus pneumoniae* polypeptide having an inner membrane domain, a *Streptococcus pneumoniae* polypeptide identified by Blastp analysis, a *Streptococcus pneumoniae* polypeptide identified by Pfam analysis, a *Streptococcus pneumoniae* lipoprotein, a *Streptococcus pneumoniae* polypeptide having a LPXTG motif, wherein the polypeptide is covalently attached to the peptidoglycan layer, a

Streptococcus pneumoniae polypeptide having a peptidoglycan binding motif, wherein the polypeptide is associated with the peptidoglycan layer, a *Streptococcus pneumoniae* polypeptide having a signal sequence and a C-terminal Tyrosine or Phenylalanine amino acid, a *Streptococcus pneumoniae* polypeptide having a tripeptide RGD sequence, a *Streptococcus pneumoniae* polypeptide identified by proteomics as surface exposed or a *Streptococcus pneumoniae* polypeptide identified by proteomics as membrane associated. In certain other embodiments, the immunogenic composition further comprises heterologous amino acids. In particular embodiments, the polypeptide is a fusion polypeptide.

In further embodiments, provided is an immunogenic composition comprising a polynucleotide having a nucleotide sequence chosen from one or more of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ IDNO: 591, a degenerate variant thereof, or a fragment thereof and is comprised in an expression vector. In preferred embodiments, the vector is plasmid DNA. In another embodiment, the polynucleotide comprises heterologous nucleotides. In still other embodiments, the polynucleotide is operatively linked to one or more gene expression regulatory elements. In yet other embodiments, the polynucleotide directs the expression of a neutralizing epitope of *Streptococcus pneumoniae*. In preferred embodiments, the immunogenic composition further comprises one or more adjuvants.

Also provided is a pharmaceutical composition comprising a polypeptide and a pharmaceutically acceptable carrier, wherein the polypeptide comprises an amino acid chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof. In preferred embodiments, the polypeptide is further defined as a *Streptococcus pneumoniae* polypeptide having 0, 1 or 2 transmembrane domains, a *Streptococcus pneumoniae* polypeptide having 3 or more transmembrane domains, a *Streptococcus pneumoniae* polypeptide having an outer membrane domain or a periplasmic domain, a *Streptococcus pneumoniae* polypeptide having an inner membrane domain, a *Streptococcus pneumoniae* polypeptide identified by Blastp analysis, a *Streptococcus pneumoniae* polypeptide identified by Pfam analysis, a *Streptococcus pneumoniae* lipoprotein, a *Streptococcus pneumoniae* polypeptide having a LPXTG motif, wherein the polypeptide is covalently attached to the peptidoglycan layer, a

Streptococcus pneumoniae polypeptide having a peptidoglycan binding motif, wherein the polypeptide is associated with the peptidoglycan layer, a *Streptococcus pneumoniae* polypeptide having a signal sequence and a C-terminal Tyrosine or Phenylalanine amino acid, a *Streptococcus pneumoniae* polypeptide having a tripeptide RGD sequence, a *Streptococcus pneumoniae* polypeptide identified by proteomics as surface exposed or a *Streptococcus pneumoniae* polypeptide identified by proteomics as membrane associated. In certain embodiments, the polypeptide further comprises heterologous amino acids. In still other embodiments, the polypeptide is a fusion polypeptide.

In another embodiment, a method of immunizing against *Streptococcus pneumoniae* is provided comprising administering to a host an immunizing amount of an immunogenic composition comprising one or more polypeptides and a pharmaceutically acceptable carrier, wherein the polypeptide comprises an amino acid sequence chosen from one or more of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof. In certain embodiments, the polypeptide is a fusion polypeptide. In other embodiments, the method further comprises administering an adjuvant.

Other embodiments of the invention provide a DNA chip comprising an array of polynucleotides, wherein at least one of the polynucleotides comprise a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591, a complement thereof, a degenerate variant thereof, or a fragment thereof.

Also provided is a protein chip comprising an array of polypeptides, wherein at least one of the polypeptides comprises an amino acid sequence chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof.

The invention further provides methods of detecting *Streptococcus pneumoniae* polynucleotides and polypeptides as well as kits for diagnosing *Streptococcus pneumoniae* infection.

Other embodiments provide a method for the detection and/or identification of *Streptococcus pneumoniae* in a biological sample comprising contacting the sample with an oligonucleotide probe of a polynucleotide comprising the nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID

NO: 431 through SEQ ID NO: 591, a degenerate variant thereof, or a fragment thereof, under conditions permitting hybridization and detecting the presence of hybridization complexes in the sample, wherein hybridization complexes indicate the presence of *Streptococcus pneumoniae* in the sample.

Still other embodiments provide a method for the detection and/or identification of *Streptococcus pneumoniae* in a biological sample comprising a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591, a degenerate variant thereof, or a fragment thereof, in the presence of nucleotides and a polymerase enzyme under conditions permitting primer extension and detecting the presence of primer extension products in the sample, wherein extension products indicate the presence of *Streptococcus pneumoniae* in the sample.

Further embodiments provide a method for the detection and/or identification of *Streptococcus pneumoniae* in a biological sample comprising contacting the sample with an antibody specific for a polypeptide comprising an amino acid sequence chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof, under conditions permitting immune complex formation and detecting the presence of immune complexes in the sample, wherein immune complexes indicate the presence of *Streptococcus pneumoniae* in the sample.

In certain embodiments, provided is a method for the detection and/or identification of antibodies to *Streptococcus pneumoniae* in a biological sample comprising contacting the sample with a polypeptide comprising an amino acid sequence chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof, under conditions permitting immune complex formation and detecting the presence of immune complexes in the sample, wherein immune complexes indicate the presence of *Streptococcus pneumoniae* in the sample.

Other embodiments of the invention provide a kit comprising a container containing an isolated polynucleotide comprising an nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591, a degenerate variant thereof, or a fragment thereof. In a preferred embodiment, the polynucleotide is a primer or a probe, wherein when the

polynucleotide is a primer, the kit further comprises a container containing a polymerase. In another embodiment, the kit further comprises a container containing dNTP.

Provided further is a kit comprising a container containing an antibody that immunospecifically binds to a polypeptide comprising the amino acid sequence chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof.

Provided also is a kit comprising a container containing an antibody that immunospecifically binds to a fusion polypeptide comprising at least the amino acid sequence chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof.

In a preferred embodiment of the invention, provided is a genetically engineered host cell, transfected, transformed or infected with a recombinant expression vector comprising a nucleotide sequence having at least about 95% identity to a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591, a degenerate variant thereof, or a fragment thereof under conditions suitable to produce one of the polypeptides of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752; and recovering the polypeptide.

Other features and advantages of the invention will be apparent from the following detailed description, from the preferred embodiments thereof, and from the claims.

DETAILED DESCRIPTION OF THE INVENTION

The invention described hereinafter addresses the need for *Streptococcus pneumoniae* immunogenic compositions that effectively prevent or treat most or all of the disease caused by serotypes of *Streptococcus pneumoniae.* The invention further addresses the need for methods of diagnosing *Streptococcus pneumoniae* infection. The present invention has identified novel *Streptococcus pneumoniae* open reading frames, hereinafter ORFs, which encode antigenic polypeptides. More particularly, the newly identified ORFs encode polypeptides that are secreted, exposed, membrane associated or surface localized on *Streptococcus pneumoniae,*

and thus serve as potential antigenic polypeptides in immunogenic compositions. Thus, in certain embodiments, the invention comprises *Streptococcus pneumoniae* polynucleotide ORFs encoding surface localized, exposed, secreted or membrane associated polypeptide antigens. The present invention therefore comprises in other embodiments, these polypeptides, preferably antigenic polypeptides, encoded by the *Streptococcus pneumoniae* ORFs.

In other embodiments, the invention comprises vectors comprising ORF sequences and host cells or animals transformed, transfected or infected with these vectors. The invention also comprises transcriptional gene products of *Streptococcus pneumoniae* ORFs, such as, for example, mRNA, antisense RNA, antisense oligonucleotides and ribozyme molecules, which can be used to inhibit or control growth of the microorganism. The invention relates also to methods of detecting these nucleic acids or polypeptides and kits for diagnosing *Streptococcus pneumoniae* infection. The invention also relates to pharmaceutical compositions, in particular immunogenic compositions, for the prevention and/or treatment of bacterial infection, in particular infection caused by or exacerbated by *Streptococcus pneumoniae*. In particular embodiments, the immunogenic compositions are used for the treatment or prevention of systemic diseases which are induced or exacerbated by *Streptococcus pneumoniae*. In other embodiments, the immunogenic compositions are used for the treatment or prevention of non-systemic diseases, particularly of the otitis media, which are induced or exacerbated by *Streptococcus pneumoniae*.

A. IDENTIFYING ORFS WITHIN THE GENOMIC SEQUENCE OF *STREPTOCOCCUS PNEUMONIAE*

The invention is directed in particular embodiments to the identification of polynucleotides, more particularly ORFs, that encode *Streptococcus pneumoniae* polypeptides. The availability of complete bacterial genome sequences has begun to play an important role in the identification of candidate antigens through genomics, transcriptional profiling, and proteomics, coupled with the information processing capabilities of bioinformatics (McAtee *et al.*, 1998a; McAtee *et al.*, 1998b; Pizza *et al.*, 2000; Sonnenberg and Belisle, 1997; Weldingh *et al.*, 1998; McAtee *et al.*, 1998c). Currently, no more than approximately 60% of all ORFs within a bacterial genome

have some match with a polypeptide whose function has been determined. This leaves approximately 40% of genomic ORFs uncharacterized. Thus, the inventors have analyzed the *Streptococcus pneumoniae* genome and utilized bioinformatic tools to identify novel ORFs encoding polypeptides of the present invention. In addition to genomic analysis, the inventors analyzed the *Streptococcus pneumoniae* membrane proteome component to identify novel and/or confirm ORFs encoding polypeptides of the present invention. As described below, the ORFs were analyzed for a variety of characteristics.

Specifically, an extensive genomic analysis was performed *in silico* of the *Streptococcus pneumoniae* type 4 genome from The Institute for Genomic Research (TIGR) using algorithms designed to identify genes that encode novel surface localized polypeptides or polypeptides with putative similarity to polypeptides of known interest in other organisms. Thus, a combined analysis of the *Streptococcus pneumoniae* genome, using a unique set of two ORF finder algorithms (*i.e.*, GLIMMER, Salzberg *et al.*, 1998 and inventors' assignee's own program), produced 3,799 ORFs. The most stringent of the ORF finders; Glimmer, produced 2,022 ORFs, while the assignee's ORF finder produced the most with 3,798 ORFs. There were 2,021 ORFs identified by the two algorithms. The difference in results between the different ORF finders is primarily due to the particular start codons used by each program; however, Glimmer also incorporates some evaluation for a Shine-Dalgarno box and an interpolated Markov model. For the purposes here, all ORFs with common stop codons are given the same ORF designation and will be treated as if they are the same ORF. As used hereinafter, an ORF is defined as having one of three potential start site codons, ATG, GTG or TTG and one of three potential stop codons, TAA, TAG or TGA. The lower limit of amino acid length selected as a cutoff (*e.g.*, ~74 amino acids) may also cause the algorithms to overlook some reading frames. However, these "true" reading frames become an increasingly rare event as the ORFs become shorter.

The initial annotation of the *Streptococcus pneumoniae* ORFs was performed using the Basic Local Alignment Search Tool (BLAST; version 2.0) Gapped search algorithm, Blastp, to identify homologous sequences (Altschul *et al.*, 1997). A cutoff 'e' value of anything $< e^{-10}$ was considered significant. The non-redundant protein sequence database used for the homology searches consisted of GenBank, SWISS-

PROT (Bairoch and Apweiler, 2000), PIR (Barker *et al.*, 2001), and TREMBL (Bairoch and Apweiler, 2000); whose database sequences are updated daily. In the present invention, ORFs with a Blastp result of > e^{-10} are considered to be unique to *Streptococcus pneumoniae*. Alternate quantitative expression values other than Blastp 'e', *e.g.*, percent identity, may also be used to compare database sequences with the *Streptococcus pneumoniae* ORFs of the present invention.

A keyword search of the entire BLAST results was carried out using known or suspected target genes for immunogenic compositions as well as words that identified the location of a protein or function.

Several parameters were used to determine grouping of the predicted *Streptococcus pneumoniae* polypeptides of the invention. For example, polypeptides destined for translocation across the cytoplasmic membrane encode a leader signal (also called signal sequence) composed of a central hydrophobic region flanked at the N-terminus by positively charged residues (Pugsley, 1993). A software program, called SignalP, which identifies signal peptides and their cleavage sites based on neural networks (Nielsen *et al.*, 1997), was used in the present invention to analyze the amino acid sequence of an ORF for such a signal peptide. The first 60 N-terminal amino acids of each ORF were analyzed by SignalP using the Gram-positive software database. The output generated four separate values, maximum C, maximum Y, maximum S, and mean S. The S-score, or signal region, is the probability of the position belonging to the signal peptide. The C-score, or cleavage site, is the probability of the position being the first in the mature protein. The Y-score is the geometric average of the C-score and a smoothed derivative of the S-score. A conclusion of either a Yes or No is given next to each score. If all four conclusions are Yes, then a 'YES' is listed for that ORF; if three of the conclusions are Yes, then a 'yes' is listed for that ORF; if two of the conclusions are Yes, then a 'maybe' is listed for that ORF; for all other cases, a 'no' is listed for that ORF.

To predict polypeptide localization in bacteria, the software program PSORT was used (Nakai, 1991). PSORT predicts localization of polypeptides to the 'cytoplasm', 'periplasm', and/or 'cytoplasmic membrane' for Gram-positive bacteria, as well as 'outer membrane' for Gram-negative bacteria. Transmembrane (TM) domains of polypeptides were analyzed using the software program TopPred II (Cserzo *et al.*, 1997).

The Hidden Markov Model (HMM) Pfam database (Bateman, 2000) was used to identify *Streptococcus pneumoniae* proteins that may belong to an existing protein family. Keyword searching of this output was further used to help identify additional candidate antigens that may have been missed by the BLAST search criteria.

A computer algorithm, called HMM Lipo, was developed by inventors' assignee to predict lipoproteins using approximately 131 biologically proven bacterial lipoproteins. The protein sequence from the start of the protein to the cysteine amino acid, plus the next two additional amino acids, was used to generate the HMM (Eddy and Markov, 1996)

The inventor's assignee's also developed a HMM using approximately 70 known prokaryotic proteins containing the LPXTG cell wall sorting signal, to predict cell wall proteins that are anchored to the peptidoglycan layer (Mazmanian *et al.*, 1999; Navarre and Schneewind, 1999). The model used not only the LPXTG sequence, but also included two features of the downstream sequence, first the hydrophobic transmembrane domain and secondly, the positively charged carboxy terminus. There are also a number of proteins that interact, non-covalently, with the peptidoglycan layer and are distinct from the LPXTG protein class described above. These proteins seem to have a consensus sequence at their carboxy terminus (Koebnik, 1995). The inventors therefore developed and used a HMM of this region to identify any *Streptococcus pneumoniae* that may fall into this class of proteins.

Streptococcus pneumoniae ORFs encoding surface localized, exposed, or membrane associated polypeptides were also identified by proteomics (*see*, Example 3). This proteomic analysis confirmed many of the *Streptococcus pneumoniae* ORFs identified by the above genomic analysis and further identified novel *Streptococcus pneumoniae* ORFs encoding membrane associated polypeptides.

The following Tables (*i.e.*, Tables 1-12) represent 12 groups into which the ORFs identified according to the above characteristics of present invention have been classified. Thus, all of the groups described below are ORFs comprised within the *Streptococcus pneumoniae* genome and identified as encoding putative surface localized, exposed, membrane associated or secreted polypeptides. These groups are not meant to limit the scope of the present invention, as analysis of additional ORF characteristics also are contemplated. These additional characteristics, *e.g.*, RGD sequence, may serve to further expand the total number of ORF groupings or

to parse the presently identified ORFs into more defined groups, broader groups, narrower groups or group subsets. In addition, some ORFs will meet the criteria of more than one category, and will therefore appear in more than one of the following groups.

Listed in Table 1 are ORFs that comprise a cytoplasmic membrane signal sequence (*i.e.*, a SignalP value of 'YES') and have one or fewer membrane spanning domains (MSD), as defined by the TopPred II program. Thirteen ORFs are found that match these criteria and are considered to be surface exposed.

Table 1. ORFs encoding surface exposed polypeptides, SignalP value = 'YES' and ≤1 MSDs.

SEQ ID	ORF
11	190
17	403
23	469
39	790
50	935
70	1143
83	1475
91	1568
97	1724
128	2271
148	2621
179	3212
209	3600

Listed in Table 2 are ORFs that comprise a cytoplasmic membrane signal sequence (*i.e.*, a SignalP value of 'YES') and an outer membrane (OM) or periplasmic (Peri) prediction value when analyzed *via* the program Psort. Five ORFs are found that match these criteria and are considered to be surface exposed.

Table 2. ORFs encoding surface exposed polypeptides, a SignalP value = 'YES' and a Psort value of 'OM or Peri'.

SEQ ID	ORF
23	469
39	790
50	935
125	2228
179	3212

Listed in Table 3 are ORFs that comprise a cytoplasmic membrane signal sequence (*i.e.*, a SignalP value of 'YES') and have 2 or more membrane spanning domains (MSD), as defined by the TopPred II program. Twenty two ORFs are found that match these criteria and are considered to be surface exposed.

Table 3. ORFs encoding surface exposed polypeptides, a SignalP = 'YES' and ≤ 1 MSDs.

SEQ ID	ORF
11	190
13	339
17	403
23	469
34	640
39	790
50	935
70	1143
73	1207
83	1475
91	1568
97	1724
106	1947
121	2196
125	2228
126	2234
128	2271
148	2621
179	3212
187	3361
192	3384
209	3600

Listed in Table 4 are ORFs that comprise at least 3 of 4 SignalP values (*i.e.*, a SignalP value of 'yes') and have 2 or more membrane spanning domains (MSD), as defined by the TopPred II program. Forty-nine ORFs are found that match these criteria and are considered to be surface exposed.

Table 4. ORFs encoding surface exposed polypeptides, a SignalP = 'yes' and ≥2 MSDs.

SEQ ID	ORF	SEQ ID	ORF
2	72	129	2304
6	94	133	2350
10	141	140	2470
14	356	145	2594
22	462	146	2613
28	597	152	2676
29	598	156	2838
36	715	168	3072
37	716	175	3141
40	823	180	3256
46	885	184	3340
47	904	188	3369
48	916	190	3373
56	989	194	3386
59	998	203	3558
71	1178	211	3631
77	1339	213	3770
80	1412	215	3799
81	1437		
86	1493		
87	1528		
88	1530		
93	1623		
99	1816		
101	1849		
102	1863		
105	1904		
112	2026		
114	2061		
115	2112		
120	2195		

Keyword search of the Blastp data for putative surface exposed proteins produced 119 ORFs and are listed in Table 5.

Table 5. ORFs encoding surface exposed polypeptides identified by keyword search of Blastp data.

SEQ ID	ORF	SEQ ID	ORF	SEQ ID	ORF	SEQ ID	ORF
1	51	88	1530	158	2847	213	3770
2	72	90	1560	159	2894	214	3789
7	113	94	1630	160	2969		
10	141	95	1632	161	2975		
12	304	96	1710	162	2979		
16	378	98	1765	163	2980		
20	410	100	1835	165	3039		
24	493	103	1864	166	3040		
27	580	105	1904	167	3060		
30	607	107	1966	169	3079		
31	612	108	1999	172	3107		
32	624	109	2001	173	3115		
33	639	112	2026	176	3167		
34	640	113	2027	177	3198		
35	703	115	2112	178	3209		
38	772	117	2132	180	3256		
40	823	118	2191	181	3262		
42	838	122	2198	182	3298		
43	854	123	2201	184	3340		
44	855	124	2215	185	3346		
48	916	127	2239	186	3349		
51	945	129	2304	188	3369		
53	979	131	2329	189	3372		
59	998	132	2348	191	3378		
60	1013	133	2350	193	3385		
61	1048	134	2352	196	3457		
65	1072	135	2354	197	3473		
67	1104	136	2385	198	3479		
68	1117	138	2431	199	3480		
69	1141	139	2452	200	3487		
70	1143	141	2488	201	3493		
71	1178	144	2591	202	3494		
75	1244	146	2613	204	3568		
76	1267	147	2615	205	3576		
77	1339	151	2661	206	3578		
78	1350	152	2676	207	3584		
79	1410	154	2734	208	3585		
80	1412	155	2814	210	3627		
87	1528	157	2845	212	3669		

HMM Pfam analysis helps identify ORFs encoding proteins with domains or amino acid patterns similar to proteins that belong to an existing protein family. Keyword search of the Pfam family classification for potential surface exposed proteins produced 52 ORFs and are listed in Table 6.

Table 6. ORFs encoding surface exposed polypeptides identified by HMM Pfam analysis.

SEQ ID	ORF	SEQ ID	ORF
4	79	160	2969
18	404	162	2979
19	406	163	2980
41	828	164	2983
45	869	165	3039
55	983	166	3040
57	992	169	3079
58	996	171	3083
63	1064	174	3140
64	1070	176	3167
66	1097	180	3256
72	1179	182	3298
74	1220	183	3327
89	1559	184	3340
92	1572	186	3349
104	1868	188	3369
111	2025	189	3372
116	2129	195	3413
119	2193	198	3479
128	2271	199	3480
137	2400	205	3576
142	2499	212	3669
143	2543	213	3770
149	2642		
151	2661		
152	2676		
153	2678		
157	2845		
159	2894		

An algorithm called HMM Lipo was developed for use in the present invention. The HMM Lipo program predicts lipoproteins using approximately 131 biologically proven bacterial lipoproteins. HMM Lipo identified 16 ORFs that are putative lipoproteins and are listed in Table 7.

Table 7. ORFs encoding surface exposed lipoproteins.

SEQ ID	ORF
3	75
8	132
9	140
13	339
21	423
26	502
34	640
62	1059
67	1104
85	1479
134	2352
147	2615
150	2655
168	3072
170	3081
173	3115

The inventors developed an HMM using approximately 70 known prokaryotic polypeptides containing the LPXTG cell wall sorting signal. Thus, this HMM was used to predict cell wall polypeptides that are anchored to the peptidoglycan layer. Listed in Table 8 are 4 ORFs predicted to have the LPXTG motif and are classified as proteins that might be targeted by sortase.

Table 8. ORFs encoding surface exposed polypeptides anchored to the peptidoglycan layer.

SEQ ID	ORF
13	339
21	423
34	640
170	3081

In addition, listed in Table 9 are 3 ORFs predicted by HMM PGB analysis to encode polypeptides potentially binding to the peptidoglycan layer in a manner independently of the sortase.

Table 9. ORFs encoding surface exposed polypeptides non-covalently anchored to the peptidoglycan layer.

SEQ ID	ORF
25	494
49	927
110	2012

ORFs that give a SignalP value of 'YES' and whose carboxy terminal amino acid is either a Phenylalanine or Tyrosine are considered to be surface exposed. Listed in Table 10 are 7 ORFs matching these criteria.

Table 10. ORFs encoding surface exposed polypeptides, a cytoplasmic membrane signal sequence (*i.e.*, SignalP = 'YES') and a C-terminal Phe or Tyr amino acid.

SEQ ID	ORF
11	190
39	790
73	1207
97	1724
106	1947
125	2228
187	3361

Twenty eight *Streptococcus pneumoniae* ORFs were additionally identified by proteomics as encoding membrane associated polypeptides and are listed in Table 11. The ORFs listed in Table 11 further support the *Streptococcus pneumoniae* ORFs identified by the genomic mining algorithms described above (*i.e.*, ORFs encoding surface localized, secreted, or exposed polypeptides; Tables 1-10).

Table 11. *Streptococcus pneumoniae* ORFs confirmed by proteomics as surface exposed.

SEQ ID	ORF
14	356
16	378
17	403
46	885
64	1070
66	1097
67	1104
69	1141
71	1178
74	1220
91	1568
103	1864
116	2129
128	2271
131	2329
136	2385
151	2661
156	2838
159	2894
162	2979
164	2983
172	3107
176	3167
178	3209
179	3212
180	3256
182	3298
205	3576

Finally, 161 novel *Streptococcus pneumoniae* ORFs were identified by proteomics as encoding membrane associated polypeptides and are listed in Table 12.

Table 12. *Streptococcus pneumoniae* ORFs identified by proteomics as membrane associated.

SEQ ID	ORF	SEQ ID	ORF	SEQ ID	ORF	SEQ ID	ORF
431	64	463	357	495	1344	527	2284
432	120	464	390	496	1347	528	2315
433	121	465	431	497	1356	529	2317
434	152	466	434	498	1417	530	2318
435	153	467	436	499	1465	531	2319
436	156	468	439	500	1477	532	2320
437	159	469	513	501	1515	533	2372
438	160	470	515	502	1527	534	2374
439	163	471	583	503	1565	535	2376
440	164	472	633	504	1601	536	2387
441	166	473	683	505	1606	537	2394
442	172	474	686	506	1641	538	2410
443	174	475	720	507	1770	539	2425
444	175	476	726	508	1773	540	2443
445	178	477	818	509	1774	541	2451
446	180	478	861	510	1785	542	2454
447	181	479	863	511	1803	543	2508
448	183	480	960	512	1817	544	2513
449	186	481	1004	513	1823	545	2542
450	188	482	1037	514	1847	546	2558
451	189	483	1049	515	1917	547	2568
452	192	484	1054	516	1923	548	2575
453	194	485	1061	517	1964	549	2587
454	199	486	1082	518	1970	550	2754
455	268	487	1105	519	2039	551	2800
456	269	488	1111	520	2041	552	2839
457	294	489	1175	521	2047	553	2892
458	296	490	1248	522	2058	554	2906
459	298	491	1262	523	2068	555	2958
460	301	492	1266	524	2130	556	2963
461	316	493	1312	525	2251	557	3021
462	320	494	1314	526	2282	558	3048

Table 12. *Streptococcus pneumoniae* ORFs identified by proteomics as membrane associated.

SEQ ID	ORF	SEQ ID	ORF	SEQ ID	ORF	SEQ ID	ORF
559	3065	569	3248	579	3552	589	3739
560	3095	570	3303	580	3555	590	3766
561	3111	571	3331	581	3560	591	3778
562	3125	572	3367	582	3564		
563	3151	573	3410	583	3566		
564	3153	574	3446	584	3632		
565	3161	575	3454	585	3653		
566	3178	576	3525	586	3714		
567	3180	577	3538	587	3732		
568	3234	578	3540	588	3735		

As further contemplated in the present invention, *Streptococcus pneumoniae* ORFs are searched and evaluated for other important characteristics. For example, proteins that contain the Arg-Gly-Asp (RGD) attachment motif, together with integrins that serve as their receptor, constitute a major recognition system for cell adhesion, and thus are putative *Streptococcus pneumoniae* polypeptide antigens. Four *Streptococcus pneumoniae* ORFs, *i.e.*, ORF 51, ORF 423, ORF 1097 and ORF 1104, have been identified as having a tripeptide RGD sequence that potentially is involved in cell attachment.

ORFs RGD recognition is one mechanism used by microbes to gain entry into eukaryotic tissues (Stockbauer *et al.*, 1999; Isberg and Nhieu, 1994). However, not all RGD-containing proteins mediate cell attachment. It has been shown that RGD-containing peptides with a proline at the carboxy end (RGDP) are inactive in cell attachment assays (Pierschbacher and Rouslahti, 1987) and are excluded. A tandem repeat finder (Benson, 1999) may also be used, as has been used to identify ORFs containing repeated DNA sequences such as those found in MSCRAMMs (Foster and Hook, 1998) and phase variable surface proteins of *Neisseria meningitidis* (Parkhill *et al.*, 2000).

The present inventors also have used the Geanfammer software to cluster proteins into homologous families (Park and Teichmann, 1998). Preliminary analysis

of the family classes has provided novel ORFs within a vaccine candidate cluster as well as defining potential protein function.

The ORFs listed in Table 13, were identified by analysis of the *Streptococcus pneumoniae* genome. A total of 215 ORFs were identified based on the analysis criteria described above and listed in Tables 1-10. The 215 ORFs identified are listed vertically in Table 13 (column 1). The nucleotide SEQ ID NOS: 1 through SEQ ID NOS: 215 (column 2) and the encoded polypeptide SEQ ID NOS: 216 through SEQ ID NOS: 430 (column 3) are listed horizontally to their respective ORF. For example, in Table 13, ORF 51 has the nucleotide sequence of SEQ ID NO:1 and the encoded polypeptide has the amino acid sequence of SEQ ID NO: 216, ORF 72 has nucleotide SEQ ID NO:2 and encoded polypeptide SEQ ID NO: 217, *etc.*

Proteomic analysis identified twenty eight ORFs (*see*, Table 11) already listed in Table 13 (*e.g.*, SEQ ID NO: 14, SEQ ID NO:16, SEQ ID NO:27, *etc.*) Proteomic analysis further identified 161 novel ORFs encoding membrane associated proteins (*see*, Table 12). These 161 novel ORFs identified by proteomics as membrane associated are listed vertically in Table 14 (column 1). The nucleotide SEQ ID NOS: 431 through SEQ ID NO: 591 (column 2) and the encoded polypeptide SEQ ID NOS: 592 through 752 (column 3) are listed horizontally to their respective ORF.

Table 13. *Streptococcus Pneumoniae* open reading frames (ORFs)

ORF	Nucleotide SEQ ID NO	Polypeptide SEQ ID NO
51	1	216
72	2	217
75	3	218
79	4	219
86	5	220
94	6	221
113	7	222
132	8	223
140	9	224
141	10	225
190	11	226
304	12	227
339	13	228
356	14	229
370	15	230
378	16	231
403	17	232
404	18	233
406	19	234
410	20	235
423	21	236
462	22	237
469	23	238
493	24	239
494	25	240
502	26	241
580	27	242
597	28	243
598	29	244
607	30	245
612	31	246
624	32	247
639	33	248
640	34	249
703	35	250
715	36	251
716	37	252
772	38	253
790	39	254
823	40	255

Table 13. *Streptococcus Pneumoniae* open reading frames (ORFs)

ORF	Nucleotide SEQ ID NO	Polypeptide SEQ ID NO
823	40	255
828	41	256
838	42	257
854	43	258
855	44	259
869	45	260
885	46	261
904	47	262
916	48	263
927	49	264
935	50	265
945	51	266
965	52	267
979	53	268
980	54	269
983	55	270
989	56	271
992	57	272
996	58	273
998	59	274
1013	60	275
1048	61	276
1059	62	277
1064	63	278
1070	64	279
1072	65	280
1097	66	281
1104	67	282
1117	68	283
1141	69	284
1143	70	285
1178	71	286
1179	72	287
1207	73	288
1220	74	289
1244	75	290
1267	76	291
1339	77	292
1350	78	293
1410	79	294

Table 13. *Streptococcus Pneumoniae* open reading frames (ORFs)

ORF	Nucleotide SEQ ID NO	Polypeptide SEQ ID NO
1412	80	295
1437	81	296
1459	82	297
1475	83	298
1476	84	299
1479	85	300
1493	86	301
1528	87	302
1530	88	303
1559	89	304
1560	90	305
1568	91	306
1572	92	307
1623	93	308
1630	94	309
1632	95	310
1710	96	311
1724	97	312
1765	98	313
1816	99	314
1835	100	315
1849	101	316
1863	102	317
1864	103	318
1868	104	319
1904	105	320
1947	106	321
1966	107	322
1999	108	323
2001	109	324
2012	110	325
2025	111	326
2026	112	327
2027	113	328
2061	114	329
2112	115	330
2129	116	331
2132	117	332
2191	118	333
2193	119	334

Table 13. ***Streptococcus Pneumoniae*** **open reading frames (ORFs)**

ORF	Nucleotide SEQ ID NO	Polypeptide SEQ ID NO
2195	120	335
2196	121	336
2198	122	337
2201	123	338
2215	124	339
2228	125	340
2234	126	341
2239	127	342
2271	128	343
2304	129	344
2322	130	345
2329	131	346
2348	132	347
2350	133	348
2352	134	349
2354	135	350
2385	136	351
2400	137	352
2431	138	353
2452	139	354
2470	140	355
2488	141	356
2499	142	357
2543	143	358
2591	144	359
2594	145	360
2613	146	361
2615	147	362
2621	148	363
2642	149	364
2655	150	365
2661	151	366
2676	152	367
2678	153	368
2734	154	369
2814	155	370
2838	156	371
2845	157	372
2847	158	373
2894	159	374

Table 13. ***Streptococcus Pneumoniae*** **open reading frames (ORFs)**

ORF	Nucleotide SEQ ID NO	Polypeptide SEQ ID NO
2969	160	375
2975	161	376
2979	162	377
2980	163	378
2983	164	379
3039	165	380
3040	166	381
3060	167	382
3072	168	383
3079	169	384
3081	170	385
3083	171	386
3107	172	387
3115	173	388
3140	174	389
3141	175	390
3167	176	391
3198	177	392
3209	178	393
3212	179	394
3256	180	395
3262	181	396
3298	182	397
3327	183	398
3340	184	399
3346	185	400
3349	186	401
3361	187	402
3369	188	403
3372	189	404
3373	190	405
3378	191	406
3384	192	407
3385	193	408
3386	194	409
3413	195	410
3457	196	411
3473	197	412
3479	198	413
3480	199	414

Table 13. ***Streptococcus Pneumoniae*** **open reading frames (ORFs)**

ORF	Nucleotide SEQ ID NO	Polypeptide SEQ ID NO
3487	200	415
3493	201	416
3494	202	417
3558	203	418
3568	204	419
3576	205	420
3578	206	421
3584	207	422
3585	208	423
3600	209	424
3627	210	425
3631	211	426
3669	212	427
3770	213	428
3789	214	429
3799	215	430

Table 14. ***Streptococcus Pneumoniae*** **open reading frames (ORFs)**

ORF	Nucleotide SEQ ID NO	Polypeptide SEQ ID NO
64	431	592
120	432	593
121	433	594
152	434	595
153	435	596
156	436	597
159	437	598
160	438	599
163	439	600
164	440	601
166	441	602
172	442	603
174	443	604
175	444	605
178	445	606
180	446	607
181	447	608
183	448	609
186	449	610
188	450	611
189	451	612
192	452	613
194	453	614
199	454	615
268	455	616
269	456	617
294	457	618
296	458	619
298	459	620
301	460	621
316	461	622
320	462	623
357	463	624
390	464	625
431	465	626
434	466	627
436	467	628

Table 14. *Streptococcus Pneumoniae* open reading frames (ORFs)

ORF	Nucleotide SEQ ID NO	Polypeptide SEQ ID NO
439	468	629
513	469	630
515	470	631
583	471	632
633	472	633
683	473	634
686	474	635
720	475	636
726	476	637
818	477	638
861	478	639
863	479	640
960	480	641
1004	481	642
1037	482	643
1049	483	644
1054	484	645
1061	485	646
1082	486	647
1105	487	648
1111	488	649
1175	489	650
1248	490	651
1262	491	652
1266	492	653
1312	493	654
1314	494	655
1344	495	656
1347	496	657
1356	497	658
1417	498	659
1465	499	660
1477	500	661
1515	501	662
1527	502	663
1565	503	664
1601	504	665

Table 14. ***Streptococcus Pneumoniae*** **open reading frames (ORFs)**

ORF	Nucleotide SEQ ID NO	Polypeptide SEQ ID NO
1606	505	666
1641	506	667
1770	507	668
1773	508	669
1774	509	670
1785	510	671
1803	511	672
1817	512	673
1823	513	674
1847	514	675
1917	515	676
1923	516	677
1964	517	678
1970	518	679
2039	519	680
2041	520	681
2047	521	682
2058	522	683
2068	523	684
2130	524	685
2251	525	686
2282	526	687
2284	527	688
2315	528	689
2317	529	690
2318	530	691
2319	531	692
2320	532	693
2372	533	694
2374	534	695
2376	535	696
2387	536	697
2394	537	698
2410	538	699
2425	539	700
2443	540	701
2451	541	702

Table 14. *Streptococcus Pneumoniae* open reading frames (ORFs)

ORF	Nucleotide SEQ ID NO	Polypeptide SEQ ID NO
2454	542	703
2508	543	704
2513	544	705
2542	545	706
2558	546	707
2568	547	708
2575	548	709
2587	549	710
2754	550	711
2800	551	712
2839	552	713
2892	553	714
2906	554	715
2958	555	716
2963	556	717
3021	557	718
3048	558	719
3065	559	720
3095	560	721
3111	561	722
3125	562	723
3151	563	724
3153	564	725
3161	565	726
3178	566	727
3180	567	728
3234	568	729
3248	569	730
3303	570	731
3331	571	732
3367	572	733
3410	573	734
3446	574	735
3454	575	736
3525	576	737
3538	577	738
3540	578	739

Table 14. ***Streptococcus Pneumoniae*** **open reading frames (ORFs)**

ORF	Nucleotide SEQ ID NO	Polypeptide SEQ ID NO
3552	579	740
3555	580	741
3560	581	742
3564	582	743
3566	583	744
3632	584	745
3653	585	746
3714	586	747
3732	587	748
3735	588	749
3739	589	750
3766	590	751
3778	591	752

B. *STREPTOCOCCUS PNEUMONIAE* ORF POLYNUCLEOTIDES ENCODING SURFACE EXPOSED POLYPEPTIDES

Isolated and purified *Streptococcus pneumoniae* ORF polynucleotides of the present invention are contemplated for use in the production of *Streptococcus pneumoniae* polypeptides. More specifically, in certain embodiments, the ORFs encode *Streptococcus pneumoniae* surface localized, exposed, membrane associated or secreted polypeptides, particularly antigenic polypeptides. Thus, in one aspect, the present invention provides isolated and purified polynucleotides (ORFs) that encode *Streptococcus pneumoniae* surface localized, exposed, membrane associated or secreted polypeptides. In particular embodiments, a polynucleotide of the present invention is a DNA molecule, wherein the DNA may be genomic DNA, chromosomal DNA, plasmid DNA or cDNA. In a preferred embodiment, a polynucleotide of the present invention is a recombinant polynucleotide, which encodes a *Streptococcus pneumoniae* polypeptide comprising an amino acid sequence that has at least 95% identity to an amino acid sequence of one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, or a fragment thereof. In another embodiment, an isolated and purified ORF polynucleotide comprises a nucleotide sequence that has at least 95% identity

to one of the ORF nucleotide sequences of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591, a degenerate variant thereof, or a complement thereof. In a preferred embodiment, an ORF polynucleotide of one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591 is comprised in a plasmid vector and expressed in a prokaryotic host cell.

As used hereinafter, the term "polynucleotide" means a sequence of nucleotides connected by phosphodiester linkages. Polynucleotides are presented hereinafter in the direction from the 5' to the 3' direction. A polynucleotide of the present invention can comprise from about 10 to about several hundred thousand base pairs. Preferably, a polynucleotide comprises from about 10 to about 3,000 base pairs. Preferred lengths of particular polynucleotide are set forth hereinafter.

A polynucleotide of the present invention can be a deoxyribonucleic acid (DNA) molecule, a ribonucleic acid (RNA) molecule, or analogs of the DNA or RNA generated using nucleotide analogs. The nucleic acid molecule can be single-stranded or double-stranded, but preferably is double-stranded DNA. Where a polynucleotide is a DNA molecule, that molecule can be a gene, a cDNA molecule or a genomic DNA molecule. Nucleotide bases are indicated hereinafter by a single letter code: adenine (A), guanine (G), thymine (T), cytosine (C), inosine (I) and uracil (U).

"Isolated" means altered "by the hand of man" from the natural state. If an "isolated" composition or substance occurs in nature, it has been changed or removed from its original environment, or both. For example, a polynucleotide or a polypeptide naturally present in a living animal is not "isolated," but the same polynucleotide or polypeptide separated from the coexisting materials of its natural state is "isolated," as the term is employed hereinafter.

Preferably, an "isolated" polynucleotide is free of sequences which naturally flank the nucleic acid (*i.e.*, sequences located at the 5' and 3' ends of the nucleic acid) in the genomic DNA of the organism from which the nucleic acid is derived. For example, in various embodiments, the isolated *Streptococcus pneumoniae* nucleic acid molecule can contain less than about 5 kb, 4 kb, 3 kb, 2 kb, 1 kb, 0. 5 kb or 0. 1 kb of nucleotide sequences which naturally flank the nucleic acid molecule in genomic DNA of the cell from which the nucleic acid is derived. However, the

Streptococcus pneumoniae nucleic acid molecule can be fused to other protein encoding or regulatory sequences and still be considered isolated.

ORF polynucleotides of the present invention may be obtained, using standard cloning and screening techniques, from a cDNA library derived from mRNA. Polynucleotides of the invention can also be obtained from natural sources such as genomic DNA libraries (*e.g.*, a *Streptococcus pneumoniae* library) or can be synthesized using well known and commercially available techniques. Contemplated in the present invention, ORF polynucleotides will be obtained using *Streptococcus pneumoniae* type 3, type 14 or type 19F chromosomal DNA as the template.

The invention further encompasses nucleic acid molecules that differ from the nucleotide sequences shown in SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591 (and fragments thereof) due to degeneracy of the genetic code and thus encode the same *Streptococcus pneumoniae* polypeptide as that encoded by the nucleotide sequence shown SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591.

Orthologues and allelic variants of the *Streptococcus pneumoniae* polynucleotides can readily be identified using methods well known in the art. Allelic variants and orthologues of the polynucleotides will comprise a nucleotide sequence that is typically at least about 70-75%, more typically at least about 80-85%, and most typically at least about 90-95% or more homologous to the nucleotide sequence shown in SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591, or a fragment of these nucleotide sequences. Such nucleic acid molecules can readily be identified as being able to hybridize, preferably under stringent conditions, to the nucleotide sequence shown in SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591, or a fragment of these nucleotide sequences.

Moreover, the polynucleotide of the invention can comprise only a fragment of the coding region of a *Streptococcus pneumoniae* polynucleotide or gene, such as a fragment of one of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591. Preferably, such fragments are immunogenic fragments.

When the ORF polynucleotides of the invention are used for the recombinant production of *Streptococcus pneumoniae* polypeptides of the present invention, the polynucleotide may include the coding sequence for the mature polypeptide, by itself,

or the coding sequence for the mature polypeptide in reading frame with other coding sequences, such as those encoding a leader or secretory sequence, a pre-, or pro- or prepro- protein sequence, or other fusion peptide portions. For example, a marker sequence which facilitates purification of the fused polypeptide can be linked to the coding sequence (*see* Gentz *et al.*, 1989, incorporated by reference hereinafter in its entirety). Thus, contemplated in the present invention is the preparation of polynucleotides encoding fusion polypeptides permitting His-tag purification of expression products. The polynucleotide may also contain non-coding 5' and 3' sequences, such as transcribed, non-translated sequences, splicing and polyadenylation signals.

Thus, a polynucleotide encoding a polypeptide of the present invention, including homologs and orthologs from species other than *Streptococcus pneumoniae*, may be obtained by a process which comprises the steps of screening an appropriate library under stringent hybridization conditions with a labeled probe having the sequence of one of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591, a fragment thereof; and isolating full-length cDNA and genomic clones containing the polynucleotide sequence. Such hybridization techniques are well known to the skilled artisan. The skilled artisan will appreciate that, in many cases, an isolated cDNA sequence will be incomplete, in that the region coding for the polypeptide is cut short at the 5' end of the cDNA. This is a consequence of reverse transcriptase, an enzyme with inherently low "processivity" (a measure of the ability of the enzyme to remain attached to the template during the polymerization reaction), failing to complete a DNA copy of the mRNA template during 1st strand cDNA synthesis.

Thus, in certain embodiments, the polynucleotide sequence information provided by the present invention allows for the preparation of relatively short DNA (or RNA) oligonucleotide sequences having the ability to specifically hybridize to gene sequences of the selected polynucleotides disclosed hereinafter. The term "oligonucleotide" as used hereinafter is defined as a molecule comprised of two or more deoxyribonucleotides or ribonucleotides, usually more than three (3), and typically more than ten (10) and up to one hundred (100) or more (although preferably between twenty and thirty). The exact size will depend on many factors, which in turn depends on the ultimate function or use of the oligonucleotide. Thus, in

particular embodiments of the invention, nucleic acid probes of an appropriate length are prepared based on a consideration of a selected nucleotide sequence, *e.g.*, a sequence such as that shown in SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591. The ability of such nucleic acid probes to specifically hybridize to a polynucleotide encoding a *Streptococcus pneumoniae* polypeptide lends them particular utility in a variety of embodiments. Most importantly, the probes can be used in a variety of assays for detecting the presence of complementary sequences in a given sample.

In certain embodiments, it is advantageous to use oligonucleotide primers. These primers may be generated in any manner, including chemical synthesis, DNA replication, reverse transcription, or a combination thereof. The sequence of such primers is designed using a polynucleotide of the present invention for use in detecting, amplifying or mutating a defined segment of an ORF polynucleotide that encodes a *Streptococcus pneumoniae* polypeptide from prokaryotic cells using polymerase chain reaction (PCR) technology.

In certain embodiments, it is advantageous to employ a polynucleotide of the present invention in combination with an appropriate label for detecting hybrid formation. A wide variety of appropriate labels are known in the art, including radioactive, enzymatic or other ligands, such as avidin/biotin, which are capable of giving a detectable signal.

Polynucleotides which are identical or sufficiently identical to a nucleotide sequence contained in one of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591, or a fragment thereof, may be used as hybridization probes for cDNA and genomnic DNA or as primers for a nucleic acid amplification (PCR) reaction, to isolate full-length cDNAs and genomic clones encoding polypeptides of the present invention and to isolate cDNA and genomic clones of other genes (including genes encoding homologs and orthologs from species other than *Streptococcus pneumoniae*) that have a high sequence similarity to the polynucleotide sequences set forth in of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591, or a fragment thereof. Typically these nucleotide sequences are from at least about 70% identical to at least about 95% identical to that of the reference polynucleotide sequence. The probes or primers will generally comprise at least 15 nucleotides, preferably, at least 30 nucleotides and

may have at least 50 nucleotides. Particularly preferred probes will have between 30 and 50 nucleotides.

There are several methods available and well known to those skilled in the art to obtain full-length cDNAs, or extend short cDNAs, for example those based on the method of Rapid Amplification of cDNA ends (RACE) (*see*, Frohman *et al.*, 1988). Recent modifications of the technique, exemplified by the Marathon™ technology (Clontech Laboratories Inc.) for example, have significantly simplified the search for longer cDNAs. In the Marathon™ technology, cDNAs have been prepared from mRNA extracted from a chosen tissue and an "adaptor" sequence ligated onto each end. Nucleic acid amplification (PCR) is then carried out to amplify the "missing" 5′ end of the cDNA using a combination of gene specific and adaptor specific oligonucleotide primers. The PCR reaction is then repeated using "nested" primers, that is, primers designed to anneal within the amplified product (typically an adaptor specific primer that anneals further 3' in the adaptor sequence and a gene specific primer that anneals further 5' in the known gene sequence). The products of this reaction can then be analyzed by DNA sequencing and a full-length cDNA constructed either by joining the product directly to the existing cDNA to give a complete sequence, or carrying out a separate full-length PCR using the new sequence information for the design of the 5' primer.

To provide certain of the advantages in accordance with the present invention, a preferred nucleic acid sequence employed for hybridization studies or assays includes probe molecules that are complementary to at least a 10 to about 70 nucleotides long stretch of a polynucleotide that encodes a *Streptococcus pneumoniae* polypeptide, such as that shown in one of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752. A size of at least 10 nucleotides in length helps to ensure that the fragment will be of sufficient length to form a duplex molecule that is both stable and selective. Molecules having complementary sequences over stretches greater than 10 bases in length are generally preferred, though, in order to increase stability and selectivity of the hybrid, and thereby improve the quality and degree of specific hybrid molecules obtained. One will generally prefer to design nucleic acid molecules having gene-complementary stretches of 25 to 40 nucleotides, 55 to 70 nucleotides, or even longer where desired. Such fragments can be readily prepared by, for example,

directly synthesizing the fragment by chemical means, by application of nucleic acid reproduction technology, such as the PCR technology of (U.S. Patent 4,683,202, incorporated hereinafter by reference) or by excising selected DNA fragments from recombinant plasmids containing appropriate inserts and suitable restriction enzyme sites.

In another aspect, the present invention contemplates an isolated and purified polynucleotide comprising a nucleotide sequence that is identical or complementary to a segment of at least 10 contiguous bases of one of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591, wherein the polynucleotide hybridizes to a polynucleotide that encodes a *Streptococcus pneumoniae* polypeptide. Preferably, the isolated and purified polynucleotide comprises a base sequence that is identical or complementary to a segment of at least 25 to about 70 contiguous bases of one of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591. For example, the polynucleotide of the invention can comprise a segment of bases identical or complementary to 40 or 55 contiguous bases of the disclosed nucleotide sequences.

Accordingly, a polynucleotide probe molecule of the invention can be used for its ability to selectively form duplex molecules with complementary stretches of the gene. Depending on the application envisioned, one will desire to employ varying conditions of hybridization to achieve varying degree of selectivity of the probe toward the target sequence (*see* Table 15 below). For applications requiring a high degree of selectivity, one will typically desire to employ relatively stringent conditions to form the hybrids. Of course, for some applications, for example, where one desires to prepare mutants employing a mutant primer strand hybridized to an underlying template or where one seeks to isolate a *Streptococcus pneumoniae* homologous polypeptide coding sequence from other cells, functional equivalents, or the like, less stringent hybridization conditions are typically needed to allow formation of the heteroduplex (*see* Table 15). Cross-hybridizing species can thereby be readily identified as positively hybridizing signals with respect to control hybridizations. Thus, hybridization conditions are readily manipulated, and thus will generally be a method of choice depending on the desired results.

Of course, for some applications, for example, where one desires to prepare mutants employing a mutant primer strand hybridized to an underlying template or

where one seeks to isolate a homologous polypeptide coding sequence from other cells, functional equivalents, or the like, less stringent hybridization conditions are typically needed to allow formation of the heteroduplex. Cross-hybridizing species are thereby readily identified as positively hybridizing signals with respect to control hybridizations. In any case, it is generally appreciated that conditions can be rendered more stringent by the addition of increasing amounts of formamide, which serves to destabilize the hybrid duplex in the same manner as increased temperature. Thus, hybridization conditions are readily manipulated, and thus will generally be a method of choice depending on the desired results.

The present invention also includes polynucleotides capable of hybridizing under reduced stringency conditions, more preferably stringent conditions, and most preferably highly stringent conditions, to polynucleotides described hereinafter. Examples of stringency conditions are shown in the table below: highly stringent conditions are those that are at least as stringent as, for example, conditions A-F; stringent conditions are at least as stringent as, for example, conditions G-L; and reduced stringency conditions are at least as stringent as, for example, conditions M-R.

Table 15
Stringency Conditions

Stringency Condition	Polynucleotide Hybrid	Hybrid Length (bp)[I]	Hybridization Temperature and Buffer[H]	Wash Temperature and Buffer[H]
A	DNA:DNA	> 50	65°C; 1xSSC -or- 42°C; 1xSSC, 50% formamide	65°C; 0.3xSSC
B	DNA:DNA	< 50	T_B; 1xSSC	T_B; 1xSSC
C	DNA:RNA	> 50	67°C; 1xSSC -or- 45°C; 1xSSC, 50% formamide	67°C; 0.3xSSC
D	DNA:RNA	< 50	T_D; 1xSSC	T_D; 1xSSC
E	RNA:RNA	> 50	70°C; 1xSSC -or- 50°C; 1xSSC, 50% formamide	70°C; 0.3xSSC
F	RNA:RNA	< 50	T_F; 1xSSC	T_F; 1xSSC
G	DNA:DNA	> 50	65°C; 4xSSC -or- 42°C; 4xSSC, 50% formamide	65°C; 1xSSC
H	DNA:DNA	< 50	T_H; 4xSSC	T_H; 4xSSC
I	DNA:RNA	> 50	67°C; 4xSSC -or- 45°C; 4xSSC, 50% formamide	67°C; 1xSSC
J	DNA:RNA	< 50	T_J; 4xSSC	T_J; 4xSSC
K	RNA:RNA	> 50	70°C; 4xSSC -or- 50°C; 4xSSC, 50% formamide	67°C; 1xSSC
L	RNA:RNA	< 50	T_L; 2xSSC	T_L; 2xSSC
M	DNA:DNA	> 50	50°C; 4xSSC -or- 40°C; 6xSSC, 50% formamide	50°C; 2xSSC
N	DNA:DNA	< 50	T_N; 6xSSC	T_N; 6xSSC

O	DNA:RNA	> 50	55°C; 4xSSC -or- 42°C; 6xSSC, 50% formamide	55°C; 2xSSC
P	DNA:RNA	< 50	T_P; 6xSSC	T_P; 6xSSC
Q	RNA:RNA	> 50	60°C; 4xSSC -or- 45°C; 6xSSC, 50% formamide	60°C; 2xSSC
R	RNA:RNA	< 50	T_R; 4xSSC	T_R; 4xSSC

(bp)[I]: The hybrid length is that anticipated for the hybridized region(s) of the hybridizing polynucleotides. When hybridizing a polynucleotide to a target polynucleotide of unknown sequence, the hybrid length is assumed to be that of the hybridizing polynucleotide. When polynucleotides of known sequence are hybridized, the hybrid length can be determined by aligning the sequences of the polynucleotides and identifying the region or regions of optimal sequence complementarity.

Buffer[H]: SSPE (1xSSPE is 0.15M NaCl, 10mM NaH_2PO_4, and 1.25mM EDTA, pH 7.4) can be substituted for SSC (1xSSC is 0.15M NaCl and 15mM sodium citrate) in the hybridization and wash buffers; washes are performed for 15 minutes after hybridization is complete.

T_B through T_R: The hybridization temperature for hybrids anticipated to be less than 50 base pairs in length should be 5-10°C less than the melting temperature (T_m) of the hybrid, where T_m is determined according to the following equations. For hybrids less than 18 base pairs in length, T_m(°C) = 2(# of A + T bases) + 4(# of G + C bases). For hybrids between 18 and 49 base pairs in length, T_m(°C) = 81.5 + 16.6($\log_{10}[Na^+]$) + 0.41(%G+C) - (600/N), where N is the number of bases in the hybrid, and $[Na^+]$ is the concentration of sodium ions in the hybridization buffer ($[Na^+]$ for 1xSSC = 0.165 M).

Additional examples of stringency conditions for polynucleotide hybridization are provided in Sambrook *et al.,* 1989, Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, chapters 9 and 11, and Ausubel *et al.,* 1995, Current Protocols in Molecular Biology, eds., John Wiley & Sons, Inc., sections 2.10 and 6.3-6.4, incorporated hereinafter by reference.

In addition to the nucleic acid molecules encoding *Streptococcus pneumoniae* polypeptides described above, another aspect of the invention pertains to isolated nucleic acid molecules which are antisense thereto. An "antisense" nucleic acid comprises a nucleotide sequence which is complementary to a "sense" nucleic acid

encoding a protein, *e.g.*, complementary to the coding strand of a double-stranded cDNA molecule or complementary to an mRNA sequence. Accordingly, an antisense nucleic acid can hydrogen bond to a sense nucleic acid. The antisense nucleic acid can be complementary to an entire *Streptococcus pneumoniae* coding strand, or to only a fragment thereof. In one embodiment, an antisense nucleic acid molecule is antisense to a "coding region" of the coding strand of a nucleotide sequence encoding a *Streptococcus pneumoniae* polypeptide.

The term "coding region" refers to the region of the nucleotide sequence comprising codons which are translated into amino acid residues, *e.g.*, the entire coding region of one of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591. In another embodiment, the antisense nucleic acid molecule is antisense to a "noncoding region" of the coding strand of a nucleotide sequence encoding a *Streptococcus pneumoniae* polypeptide. The term "noncoding region" refers to 5' and 3' sequences that flank the coding region that are not translated into amino acids (*i.e.*, also referred to as 5' and 3' untranslated regions).

Given the coding strand sequence encoding the *Streptococcus pneumoniae* polypeptide disclosed hereinafter (*e.g.*, one of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 571), antisense nucleic acids of the invention can be designed according to the rules of Watson and Crick base pairing. The antisense nucleic acid molecule can be complementary to the entire coding region of *Streptococcus pneumoniae* mRNA, but more preferably is an oligonucleotide which is antisense to only a fragment of the coding or noncoding region of *Streptococcus pneumoniae* mRNA. For example, the antisense oligonucleotide can be complementary to the region surrounding the translation start site of *Streptococcus pneumoniae* mRNA.

An antisense oligonucleotide can be, for example, about 5, 10, 15, 20, 25, 30, 35, 40, 45 or 50 nucleotides in length. An antisense nucleic acid of the invention can be constructed using chemical synthesis and enzymatic ligation reactions using procedures known in the art. For example, an antisense nucleic acid (*e.g.*, an antisense oligonucleotide) can be chemically synthesized using naturally occurring nucleotides or variously modified nucleotides designed to increase the biological stability of the molecules or to increase the physical stability of the duplex formed between the antisense and sense nucleic acids, *e.g.*, phosphorothioate derivatives

and acridine substituted nucleotides can be used. Examples of modified nucleotides which can be used to generate the antisense nucleic acid include 5-fluorouracil, 5-bromouracil, 5-chlorouracil, 5-iodouracil, hypoxanthine, xanthine, 4-acetylcytosine, 5-(carboxyhydroxylmethyl) uracil, 5-carboxymethylaminomethyl-2-thiouridine, 5-carboxymethylaminomethyluracil, dihydrouracil, beta-D-galactosylqueosine, inosine, N6-isopentenyladenine, l-methylguanine, l-methylinosine, 2,2-dimethylguanine, 2-methyladenine, 2-methylguanine, 3-methylcytosine, 5-methylcytosine, N6-adenine, 7-methylguanine, 5-methylaminomethyluracil, 5-methoxyaminomethyl-2-thiouracil, beta-D-mannosylqueosine, 5'-methoxycarboxymethyluracil, 5-methoxyuracil, 2-methylthio-N6-isopentenyladenine, uracil-5-oxyacetic acid (v), wybutoxosine, pseudouracil, queosine, 2-thiocytosine, 5-methyl-2-thiouracil, 2-thiouracil, 4-thiouracil, 5-methyluracil, uracil-5-oxyacetic acid methylester, uracil-5-oxyacetic acid (v), 5-methyl-2-thiouracil, 3-(3-amino-3-N-2-carboxypropyl) uracil, (acp3)w, and 2,6-diaminopurine.

Alternatively, the antisense nucleic acid can be produced biologically using an expression vector into which a nucleic acid has been subcloned in an antisense orientation (*i.e.*, RNA transcribed from the inserted nucleic acid will be of an antisense orientation to a target nucleic acid of interest, described further in the following subsection).

The antisense nucleic acid molecules of the invention are typically administered to a subject or generated *in situ* such that they hybridize with or bind to cellular mRNA and/or genomic DNA encoding a *Streptococcus pneumoniae* polypeptide to thereby inhibit expression of the polypeptide, *e.g.*, by inhibiting transcription and/or translation. The hybridization can be by conventional nucleotide complementarity to form a stable duplex, or, for example, in the case of an antisense nucleic acid molecule which binds to DNA duplexes, through specific interactions in the major groove of the double helix. An example of a route of administration of an antisense nucleic acid molecule of the invention includes direct injection at a tissue site. Alternatively, an antisense nucleic acid molecule can be modified to target selected cells and then administered systemically. For example, for systemic administration, an antisense molecule can be modified such that it specifically binds to a receptor or an antigen expressed on a selected cell surface, *e.g.*, by linking the antisense nucleic acid molecule to a peptide or an antibody which binds to a cell

surface receptor or antigen. The antisense nucleic acid molecule can also be delivered to cells using the vectors described hereinafter.

In yet another embodiment, the antisense nucleic acid molecule of the invention is an α-anomeric nucleic acid molecule. An α-anomeric nucleic acid molecule forms specific double-stranded hybrids with complementary RNA in which, contrary to the usual γ-units, the strands run parallel to each other (Gaultier *et al.*, 1987). The antisense nucleic acid molecule can also comprise a 2'-o-methylribonucleotide (Inoue *et al.*, 1987 (a)) or a chimeric RNA-DNA analogue (Inoue *et al.*, 1987(b)).

In still another embodiment, an antisense nucleic acid of the invention is a ribozyme. Ribozymes are catalytic RNA molecules with ribonuclease activity which are capable of cleaving a single-stranded nucleic acid, such as an mRNA, to which they have a complementary region. Thus, ribozymes (*e.g.*, hammerhead ribozymes (described in Haselhoff and Gerlach, 1988)) can be used to catalytically cleave *Streptococcus pneumoniae* mRNA transcripts to thereby inhibit translation of *Streptococcus pneumoniae* mRNA. A ribozyme having specificity for a *Streptococcus pneumoniae*-encoding nucleic acid can be designed based upon the nucleotide sequence of a *Streptococcus pneumoniae* cDNA disclosed hereinafter (*i.e.*, SEQ ID NO:l through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591). For example, a derivative of a Tetrahymena L-19 IVS RNA can be constructed in which the nucleotide sequence of the active site is complementary to the nucleotide sequence to be cleaved in a *Streptococcus pneumoniae*-encoding mRNA. *See*, *e.g.*, Cech *et al.* U.S. Patent 4,987,071 and Cech *et al.* U.S. Patent 5,116,742 both incorporated by reference. Alternatively, *Streptococcus pneumoniae* mRNA can be used to select a catalytic RNA having a specific ribonuclease activity from a pool of RNA molecules. *See*, *e.g.*, Bartel and Szostak, 1993.

Alternatively *Streptococcus pneumoniae* gene expression can be inhibited by targeting nucleotide sequences complementary to the regulatory region of the *Streptococcus pneumoniae* gene (*e.g.* , the *Streptococcus pneumoniae* gene promoter and/or enhancers) to form triple helical structures that prevent transcription of the *Streptococcus pneumoniae* gene in target cells. *See* generally, Helene, 1991; Helene *et al.*, 1992; and Maher, 1992.

Streptococcus pneumoniae gene expression can also be inhibited using RNA interference (RNAi). This is a technique for post-transcriptional gene silencing (PTGS), in which target gene activity is specifically abolished with cognate double-stranded RNA (dsRNA). RNAi resembles in many aspects PTGS in plants and has been detected in many invertebrates including trypanosome, hydra, planaria, nematode and fruit fly (*Drosophila melangnoster*). It may be involved in the modulation of transposable element mobilization and antiviral state formation . RNAi in mammalian systems is disclosed in International Application WO 00/63364 which is incorporated by reference hereinafter in its entirety. Basically, dsRNA of at least about 600 nucleotides, homologous to the target is introduced into the cell and a sequence specific reduction in gene activity is observed.

C. *STREPTOCOCCUS PNEUMONIAE* POLYPEPTIDES

In particular embodiments, the present invention provides isolated and purified *Streptococcus pneumoniae* polypeptides. Preferably, a *Streptococcus pneumoniae* polypeptide of the invention is a recombinant polypeptide. In certain embodiments, a *Streptococcus pneumoniae* polypeptide of the present invention comprises the amino acid sequence that has at least 95% identity to the amino acid sequence of one of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752 a biological equivalent thereof, or a fragment thereof.

A *Streptococcus pneumoniae* polypeptide according to the present invention encompasses a polypeptide that comprises: 1) the amino acid sequence shown in one of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 or SEQ ID NO: 752; 2) functional and non-functional naturally occurring variants or biological equivalents of *Streptococcus pneumoniae* polypeptides of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through 752; 3) recombinantly produced variants or biological equivalents of *Streptococcus pneumoniae* polypeptides of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752; and 4) polypeptides isolated from organisms other than *Streptococcus pneumoniae* (orthologues of *Streptococcus pneumoniae* polypeptides.)

A biological equivalent or variant of a *Streptococcus pneumoniae* polypeptide according to the present invention encompasses 1) a polypeptide isolated from

Streptococcus pneumoniae; and 2) a polypeptide that contains substantially homology to a *Streptococcus pneumoniae* polypeptide.

Biological equivalents or variants of *Streptococcus pneumoniae* include both functional and non-functional *Streptococcus pneumoniae* polypeptides. Functional biological equivalents or variants are naturally occurring amino acid sequence variants of a *Streptococcus pneumoniae* polypeptide that maintains the ability to elicit an immunological or antigenic response in a subject. Functional variants will typically contain only conservative substitution of one or more amino acids of one of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752, or substitution, deletion or insertion of non-critical residues in non-critical regions of the polypeptide (*e.g.,* not in regions containing antigenic determinants or protective epitopes).

The present invention further provides non-*Streptococcus pneumoniae* orthologues of *Streptococcus pneumoniae* polypeptides. Orthologues of *Streptococcus pneumoniae* polypeptides are polypeptides that are isolated from non-*Streptococcus pneumoniae* organisms and possess antigenic capabilities of the *Streptococcus pneumoniae* polypeptide. Orthologues of a *Streptococcus pneumoniae* polypeptide can readily be identified as comprising an amino acid sequence that is substantially homologous to one of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752.

Modifications and changes can be made in the structure of a polypeptide of the present invention and still obtain a molecule having *Streptococcus pneumoniae* antigenicity. For example, certain amino acids can be substituted for other amino acids in a sequence without appreciable loss of antigenicity. Because it is the interactive capacity and nature of a polypeptide that defines that polypeptide's biological functional activity, certain amino acid sequence substitutions can be made in a polypeptide sequence (or, of course, its underlying DNA coding sequence) and nevertheless obtain a polypeptide with like properties.

In making such changes, the hydropathic index of amino acids can be considered. The importance of the hydropathic amino acid index in conferring interactive biologic function on a polypeptide is generally understood in the art (Kyte & Doolittle, 1982). It is known that certain amino acids can be substituted for other amino acids having a similar hydropathic index or score and still result in a

polypeptide with similar biological activity. Each amino acid has been assigned a hydropathic index on the basis of its hydrophobicity and charge characteristics. Those indices are: isoleucine (+4.5); valine (+4.2); leucine (+3.8); phenylalanine (+2.8); cysteine/cystine (+2.5); methionine (+1.9); alanine (+1.8); glycine (-0.4); threonine (-0.7); serine (-0.8); tryptophan (-0.9); tyrosine (-1.3); proline (-1.6); histidine (-3.2); glutamate (-3.5); glutamine (-3.5); aspartate (-3.5); asparagine (-3.5); lysine (-3.9); and arginine (-4.5).

It is believed that the relative hydropathic character of the amino acid residue determines the secondary and tertiary structure of the resultant polypeptide, which in turn defines the interaction of the polypeptide with other molecules, such as enzymes, substrates, receptors, antibodies, antigens, and the like. It is known in the art that an amino acid can be substituted by another amino acid having a similar hydropathic index and still obtain a functionally equivalent polypeptide. In such changes, the substitution of amino acids whose hydropathic indices are within +/-2 is preferred, those that are within +/-1 are particularly preferred, and those within +/-0.5 are even more particularly preferred.

Substitution of like amino acids can also be made on the basis of hydrophilicity, particularly where the biological functional equivalent polypeptide or peptide thereby created is intended for use in immunological embodiments. U.S. Patent 4,554,101, incorporated hereinafter by reference, states that the greatest local average hydrophilicity of a polypeptide, as governed by the hydrophilicity of its adjacent amino acids, correlates with its immunogenicity and antigenicity, *i.e.* with a biological property of the polypeptide.

As detailed in U.S. Patent 4,554,101, the following hydrophilicity values have been assigned to amino acid residues: arginine (+3.0); lysine (+3.0); aspartate (+3.0 ±1); glutamate (+3.0 ±1); serine (+0.3); asparagine (+0.2); glutamine (+0.2); glycine (0); proline (-0.5 ±1); threonine (-0.4); alanine (-0.5); histidine (-0.5); cysteine (-1.0); methionine (-1.3); valine (-1.5); leucine (-1.8); isoleucine (-1.8); tyrosine (-2.3); phenylalanine (-2.5); tryptophan (-3.4). It is understood that an amino acid can be substituted for another having a similar hydrophilicity value and still obtain a biologically equivalent, and in particular, an immunologically equivalent polypeptide. In such changes, the substitution of amino acids whose hydrophilicity values are

within ±2 is preferred, those that are within ±1 are particularly preferred, and those within ±0.5 are even more particularly preferred.

As outlined above, amino acid substitutions are generally therefore based on the relative similarity of the amino acid side-chain substituents, for example, their hydrophobicity, hydrophilicity, charge, size, and the like. Exemplary substitutions which take various of the foregoing characteristics into consideration are well known to those of skill in the art and include: arginine and lysine; glutamate and aspartate; serine and threonine; glutamine and asparagine; and valine, leucine and isoleucine (*See* Table 16, below). The present invention thus contemplates functional or biological equivalents of a *Streptococcus pneumoniae* polypeptide as set forth above.

TABLE 16
Amino Acid Substitutions

Original Residue	Exemplary Residue Substitution
Ala	Gly; Ser
Arg	Lys
Asn	Gln; His
Asp	Glu
Cys	Ser
Gln	Asn
Glu	Asp
Gly	Ala
His	Asn; Gln
Ile	Leu; Val
Leu	Ile; Val
Lys	Arg
Met	Leu; Tyr
Ser	Thr
Thr	Ser
Trp	Tyr
Tyr	Trp; Phe
Val	Ile; Leu

Biological or functional equivalents of a polypeptide can also be prepared using site-specific mutagenesis. Site-specific mutagenesis is a technique useful in the preparation of second generation polypeptides, or biologically functional equivalent polypeptides or peptides, derived from the sequences thereof, through specific mutagenesis of the underlying DNA. As noted above, such changes can be

desirable where amino acid substitutions are desirable. The technique further provides a ready ability to prepare and test sequence variants, for example, incorporating one or more of the foregoing considerations, by introducing one or more nucleotide sequence changes into the DNA. Site-specific mutagenesis allows the production of mutants through the use of specific oligonucleotide sequences which encode the DNA sequence of the desired mutation, as well as a sufficient number of adjacent nucleotides, to provide a primer sequence of sufficient size and sequence complexity to form a stable duplex on both sides of the deletion junction being traversed. Typically, a primer of about 17 to 25 nucleotides in length is preferred, with about 5 to 10 residues on both sides of the junction of the sequence being altered.

In general, the technique of site-specific mutagenesis is well known in the art. As will be appreciated, the technique typically employs a phage vector which can exist in both a single stranded and double stranded form. Typically, site-directed mutagenesis in accordance herewith is performed by first obtaining a single-stranded vector which includes within its sequence a DNA sequence which encodes all or a portion of the *Streptococcus pneumoniae* polypeptide sequence selected. An oligonucleotide primer bearing the desired mutated sequence is prepared (*e.g.*, synthetically). This primer is then annealed to the singled-stranded vector, and extended by the use of enzymes such as *E. coli* polymerase I Klenow fragment, in order to complete the synthesis of the mutation-bearing strand. Thus, a heteroduplex is formed wherein one strand encodes the original non-mutated sequence and the second strand bears the desired mutation. T his heteroduplex vector is then used to transform appropriate cells such as *E. coli* cells and clones are selected which include recombinant vectors bearing the mutation. Commercially available kits come with all the reagents necessary, except the oligonucleotide primers.

A *Streptococcus pneumoniae* polypeptide or polypeptide antigen of the present invention is understood to be any *Streptococcus pneumoniae* polypeptide comprising substantial sequence similarity, structural similarity and/or functional similarity to a *Streptococcus pneumoniae* polypeptide comprising the amino acid sequence of one of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752. In addition, a *Streptococcus pneumoniae* polypeptide or polypeptide antigen of the invention is not limited to a particular source. Thus, the

invention provides for the general detection and isolation of the polypeptides from a variety of sources.

It is contemplated in the present invention, that a *Streptococcus pneumoniae* polypeptide may advantageously be cleaved into fragments for use in further structural or functional analysis, or in the generation of reagents such as *Streptococcus pneumoniae*-related polypeptides and *Streptococcus pneumoniae*-specific antibodies. This can be accomplished by treating purified or unpurified *Streptococcus pneumoniae* polypeptides with a peptidase such as endoproteinase glu-C (Boehringer, Indianapolis, IN). Treatment with CNBr is another method by which peptide fragments may be produced from natural *Streptococcus pneumoniae* polypeptides. Recombinant techniques also can be used to produce specific fragments of a *Streptococcus pneumoniae* polypeptide.

In addition, the inventors also contemplate that compounds sterically similar to a particular *Streptococcus pneumoniae* polypeptide antigen may be formulated to mimic the key portions of the peptide structure, called peptidomimetics. Mimetics are peptide-containing molecules which mimic elements of protein secondary structure. (see, *e.g.* Johnson *et al.*, 1993). The underlying rationale behind the use of peptide mimetics is that the peptide backbone of proteins exists chiefly to orient amino acid side chains in such a way as to facilitate molecular interactions, such as those of receptor and ligand.

Successful applications of the peptide mimetic concept have thus far focused on mimetics of β-turns within proteins. Likely β-turn structures within *Streptococcus pneumoniae* can be predicted by computer-based algorithms as discussed above. Once the component amino acids of the turn are determined, mimetics can be constructed to achieve a similar spatial orientation of the essential elements of the amino acid side chains, as discussed in Johnson *et al.*, 1993.

Fragments of the *Streptococcus pneumoniae* polypeptides are also included in the invention. A fragment is a polypeptide having an amino acid sequence that entirely is the same as part, but not all, of the amino acid sequence. The fragment can comprise, for example, at least 7 or more (*e.g.,* 8, 10, 12, 14, 16, 18, 20, or more) contiguous amino acids of an amino acid sequence of one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO:592 through SEQ ID NO: 752. Fragments may be "freestanding" or comprised within a larger polypeptide of which they form a

part or region, most preferably as a single, continuous region. In one embodiment, the fragments include at least one epitope of the mature polypeptide sequence.

"Fusion protein" refers to a protein or polypeptide encoded by two, often unrelated, fused genes or fragments thereof. For example, fusion proteins or polypeptides comprising various portions of constant region of immunoglobulin molecules together with another human protein or part thereof have been described. In many cases, employing an immunoglobulin Fc region as a part of a fusion protein or polypeptide is advantageous for use in therapy and diagnosis resulting in, for example, improved pharmacokinetic properties (*see e.g.*, International Application EP-A 0232 2621). On the other hand, for some uses it would be desirable to be able to delete the Fc part after the fusion protein or polypeptide has been expressed, detected and purified.

D. *STREPTOCOCCUS PNEUMONIAE* POLYNUCLEOTIDE AND POLYPEPTIDE VARIANTS

"Variant" as the term is used hereinafter, is a polynucleotide or polypeptide that differs from a reference polynucleotide or polypeptide respectively, but retains essential properties. A typical variant of a polynucleotide differs in nucleotide sequence from another, reference polynucleotide. Changes in the nucleotide sequence of the variant may or may not alter the amino acid sequence of a polypeptide encoded by the reference polynucleotide. Nucleotide changes may result in amino acid substitutions, additions, deletions, fusions and truncations in the polypeptide encoded by the reference sequence, as discussed below. A typical variant of a polypeptide differs in amino acid sequence from another, reference polypeptide. Generally, differences are limited so that the sequences of the reference polypeptide and the variant are closely similar overall and, in many regions, identical. A variant and reference polypeptide may differ in amino acid sequence by one or more substitutions, additions, deletions in any combination. A substituted or inserted amino acid residue may or may not be one encoded by the genetic code. A variant of a polynucleotide or polypeptide may be a naturally occurring such as an allelic variant, or it may be a variant that is not known to occur naturally. Non-naturally occurring variants of polynucleotides and polypeptides may be made by mutagenesis techniques or by direct synthesis.

"Identity," as known in the art, is a relationship between two or more polypeptide sequences or two or more polynucleotide sequences, as determined by comparing the sequences. In the art, "identity" also means the degree of sequence relatedness between polypeptide or polynucleotide sequences, as the case may be, as determined by the match between strings of such sequences. "Identity" and "similarity" can be readily calculated by known methods, including but not limited to those described in (Computational Molecular Biology, Lesk, A. M., ed., Oxford University Press, New York, 1988; Biocomputing: Informatics and Genome Projects, Smith, D. W., ed., Academic Press, New York, 1993; Computer Analysis of Sequence Data, Part I, Griffin, A. M., and Griffin, H. G., eds., Humana Press, New Jersey, 1994; Sequence Analysis in Molecular Biology, von Heinje, G., Academic Press, 1987; and Sequence Analysis Primer, Gribskov, M. and Devereux, J., eds., M Stockton Press, New York, 1991; and Carillo, H., and Lipman, D., SIAM J. Applied Math., 48: 1073 (1988). Preferred methods to determine identity are designed to give the largest match between the sequences tested. Methods to determine identity and similarity are codified in publicly available computer programs. Preferred computer program methods to determine identity and similarity between two sequences include, but are not limited to, the GCG program package (Devereux, J., *et al* 1984), BLASTP, BLASTN, TBLASTN and FASTA (Altschul, S. F., *et al.*, 1990). The BLASTX program is publicly available from NCBI and other sources (BLAST Manual, Altschul, S., *et al.*, NCBI NLM NIH Bethesda, Md. 20894; Altschul, S., *et al.*, 1990). The well known Smith-Waterman algorithm may also be used to determine identity.

By way of example, a polynucleotide sequence of the present invention may be identical to the reference sequence of one of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591, that is be 100% identical, or it may include up to a certain integer number of nucleotide alterations as compared to the reference sequence. Such alterations are selected from the group consisting of at least one nucleotide deletion, substitution, including transition and transversion, or insertion, and wherein said alterations may occur at the 5' or 3' terminal positions of the reference nucleotide sequence or anywhere between those terminal positions, interspersed either individually among the nucleotides in the reference sequence or in one or more contiguous groups within the reference sequence. The number of

nucleotide alterations is determined by multiplying the total number of nucleotides in one of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591 by the numerical percent of the respective percent identity (divided by 100) and subtracting that product from said total number of nucleotides in one of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591.

For example, an isolated *Streptococcus pneumoniae* polynucleotide comprising a polynucleotide sequence that has at least 70% identity to the nucleic acid sequence of one of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591; a degenerate variant thereof or a fragment thereof, wherein the polynucleotide sequence may include up to n_n nucleic acid alterations over the entire polynucleotide region of the nucleic acid sequence of one of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591, wherein n_n is the maximum number of alterations and is calculated by the formula:

$$n_n \leq x_n - (x_n \bullet y),$$

in which x_n is the total number of nucleic acids of one of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591 and y has a value of 0.70, wherein any non-integer product of x_n and y is rounded down to the nearest integer prior to subtracting such product from x_n. Of course, y may also have a value of 0.80 for 80%, 0.85 for 85%, 0.90 for 90% 0.95 for 95%, *etc.* Alterations of a polynucleotide sequence encoding one of the polypeptides of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752 may create nonsense, missense or frameshift mutations in this coding sequence and thereby alter the polypeptide encoded by the polynucleotide following such alterations.

Similarly, a polypeptide sequence of the present invention may be identical to the reference sequence of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752, that is be 100% identical, or it may include up to a certain integer number of amino acid alterations as compared to the reference sequence such that the % identity is less than 100%. Such alterations are selected from the group consisting of at least one amino acid deletion, substitution, including conservative and non-conservative substitution, or insertion, and wherein said alterations may occur at the amino- or carboxy-terminal positions of the reference polypeptide sequence or anywhere between those terminal positions, interspersed either individually among the amino acids in the reference sequence or in one or

more contiguous groups within the reference sequence. The number of amino acid alterations for a given % identity is determined by multiplying the total number of amino acids in one of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752 by the numerical percent of the respective percent identity (divided by 100) and then subtracting that product from said total number of amino acids in one of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752, or:

$$n_a \leq x_a-(x_a \bullet y),$$

wherein n_a is the number of amino acid alterations, x_a is the total number of amino acids in one of SEQ ID NO:216 through SEQ ID NO:430 SEQ ID NO: 592 through SEQ ID NO: 752, and y is, for instance 0.70 for 70%, 0.80 for 80%, 0.85 for 85% etc., and wherein any non-integer product of x_a and y is rounded down to the nearest integer prior to subtracting it from x_a.

E. VECTORS, HOST CELLS AND RECOMBINANT *STREPTOCOCCUS PNEUMONIAE* POLYPEPTIDES

In a preferred embodiment, the present invention provides expression vectors comprising ORF polynucleotides that encode *Streptococcus pneumoniae* polypeptides. Preferably, the expression vectors of the present invention comprise ORF polynucleotides that encode *Streptococcus pneumoniae* polypeptides comprising the amino acid residue sequence of one of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752. More preferably, the expression vectors of the present invention comprise a polynucleotide comprising the nucleotide base sequence of one of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591. Even more preferably, the expression vectors of the invention comprise a polynucleotide operatively linked to an enhancer-promoter. More preferably still, the expression vectors of the invention comprise polynucleotide operatively linked to a prokaryotic promoter. Alternatively, the expression vectors of the present invention comprise polynucleotide operatively linked to an enhancer-promoter that is a eukaryotic promoter, and the expression vectors further comprise a polyadenylation signal that is positioned 3' of the carboxy-terminal amino acid and within a transcriptional unit of the encoded polypeptide.

Expression of proteins in prokaryotes is most often carried out in *E. coli* with vectors containing constitutive or inducible promoters directing the expression of either fusion or non-fusion proteins. Fusion vectors add a number of amino acids to a protein encoded therein, usually to the amino terminus of the recombinant protein. Such fusion vectors typically serve three purposes: 1) to increase expression of recombinant protein; 2) to increase the solubility of the recombinant protein; and 3) to aid in the purification of the recombinant protein by acting as a ligand in affinity purification. Often, in fusion expression vectors, a proteolytic cleavage site is introduced at the junction of the fusion moiety and the recombinant protein to enable separation of the recombinant protein from the fusion moiety subsequent to purification of the fusion protein. Such enzymes, and their cognate recognition sequences, include Factor Xa, thrombin and enterokinase.

Typical fusion expression vectors include pGEX (Pharmacia Biotech Inc; Smith and Johnson,1988), pMAL (New England Biolabs, Beverly; MA) and pRIT5 (Pharmacia, Piscataway, NJ) which fuse glutathione S- transferase (GST), maltose E binding protein, or protein A, respectively, to the target recombinant protein.

In one embodiment, the coding sequence of the *Streptococcus pneumoniae* polynucleotide is cloned into a pGEX expression vector to create a vector encoding a fusion protein comprising, from the N-terminus to the C-terminus, GST-thrombin cleavage site-*Streptococcus pneumoniae* polypeptide. The fusion protein can be purified by affinity chromatography using glutathione-agarose resin. Recombinant *Streptococcus pneumoniae* polypeptide unfused to GST can be recovered by cleavage of the fusion protein with thrombin.

Examples of suitable inducible non-fusion *E. coli* expression vectors include pTrc (Amann *et al.*, 1988), pET lld (Studier *et al.*, 1990), pBAD and pCRT7. Target gene expression from the pTrc vector relies on host RNA polymerase transcription from a hybrid trp-lac fusion promoter. Target gene expression from the pET lld vector relies on transcription from a T7 gn1 0-lac fusion promoter mediated by a coexpressed viral RNA polymerase J7 gnl. This viral polymerase is supplied by host strains BL21 (DE3) or HMS I 74(DE3) from a resident prophage harboring a T7 gnl gene under the transcriptional control of the lacUV 5 promoter.

One strategy to maximize recombinant protein expression in *E. coli* is to express the protein in a host bacterium with an impaired capacity to proteolytically

cleave the recombinant protein. Another strategy is to alter the nucleic acid sequence of the nucleic acid to be inserted into an expression vector so that the individual codons for each amino acid are those preferentially utilized in *E. coli*. Such alteration of nucleic acid sequences of the invention can be carried out by standard DNA mutagenesis or synthesis techniques.

In another embodiment, the *Streptococcus pneumoniae* polynucleotide expression vector is a yeast expression vector. Examples of vectors for expression in yeast *S. cerivisae* include pYepSec I (Baldari, *et al.*, 1987), pMFa (Kurjan and Herskowitz, 1982), pJRY88 (Schultz *et al.*, 1987), and pYES2 (Invitrogen Corporation, San Diego, CA).

Alternatively, a *Streptococcus pneumoniae* polynucleotide can be expressed in insect cells using, for example, baculovirus expression vectors. Baculovirus vectors available for expression of proteins in cultured insect cells (*e.g.*, Sf 9 cells) include the pAc series (Smith *et al.*, 1983) and the pVL series (Lucklow and Summers, 1989).

In yet another embodiment, a nucleic acid of the invention is expressed in mammalian cells using a mammalian expression vector. Examples of mammalian expression vectors include pCDM8 (Seed, 1987) and pMT2PC (Kaufman *et al.*, 1987). When used in mammalian cells, the expression vector's control functions are often provided by viral regulatory elements.

As used hereinafter, a promoter is a region of a DNA molecule typically within about 100 nucleotide pairs in front of (upstream of) the point at which transcription begins (*i.e.*, a transcription start site). That region typically contains several types of DNA sequence elements that are located in similar relative positions in different genes. As used hereinafter, the term "promoter" includes what is referred to in the art as an upstream promoter region, a promoter region or a promoter of a generalized eukaryotic RNA Polymerase II transcription unit.

Another type of discrete transcription regulatory sequence element is an enhancer. An enhancer provides specificity of time, location and expression level for a particular encoding region (*e.g.*, gene). A major function of an enhancer is to increase the level of transcription of a coding sequence in a cell that contains one or more transcription factors that bind to that enhancer. Unlike a promoter, an enhancer

can function when located at variable distances from transcription start sites so long as a promoter is present.

As used hereinafter, the phrase "enhancer-promoter" means a composite unit that contains both enhancer and promoter elements. An enhancer-promoter is operatively linked to a coding sequence that encodes at least one gene product. As used hereinafter, the phrase "operatively linked" means that an enhancer-promoter is connected to a coding sequence in such a way that the transcription of that coding sequence is controlled and regulated by that enhancer-promoter. Means for operatively linking an enhancer-promoter to a coding sequence are well known in the art. As is also well known in the art, the precise orientation and location relative to a coding sequence whose transcription is controlled, is dependent *inter alia* upon the specific nature of the enhancer-promoter. Thus, a TATA box minimal promoter is typically located from about 25 to about 30 base pairs upstream of a transcription initiation site and an upstream promoter element is typically located from about 100 to about 200 base pairs upstream of a transcription initiation site. In contrast, an enhancer can be located downstream from the initiation site and can be at a considerable distance from that site.

An enhancer-promoter used in a vector construct of the present invention can be any enhancer-promoter that drives expression in a cell to be transfected. By employing an enhancer-promoter with well-known properties, the level and pattern of gene product expression can be optimized.

For example, commonly used promoters are derived from polyoma, Adenovirus 2, cytomegalovirus and Simian Virus 40. For other suitable expression systems for both prokaryotic and eukaryotic cells see chapters 16 and 17 of Sambrook *et al.*, "Molecular Cloning: A Laboratory Manual" 2nd, ed, Cold Spring Harbor Laboratory, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 1989, incorporated hereinafter by reference.

In another embodiment, the recombinant mammalian expression vector is capable of directing expression of the nucleic acid preferentially in a particular cell type (*e.g.*, tissue-specific regulatory elements are used to express the nucleic acid). Tissue-specific regulatory elements are known in the art. Non-limiting examples of suitable tissue-specific promoters include the albumin promoter (liver-specific; Pinkert *et al.*, 1987), lymphoid-specific promoters (Calame and Eaton, 1988), in particular,

promoters of T cell receptors (Winoto and Baltimore, 1989) and immunoglobulins (Banerji *et al.*, 1983), Queen and Baltimore (1983), neuron-specific promoters (*e.g.*, the neurofilament promoter; Byrne and Ruddle, 1989), pancreas-specific promoters (Edlund *et al.*, 1985), and mammary gland-specific promoters (*e.g.*, milk whey promoter; U.S. Patent 4,873,316 and International Application EP 264,166). Developmentally-regulated promoters are also encompassed, for example the murine hox promoters (Kessel and Gruss, 1990) and the α-fetoprotein promoter (Campes and Tilghman, 1989).

The invention further provides a recombinant expression vector comprising a DNA molecule encoding a *Streptococcus pneumoniae* polypeptide cloned into the expression vector in an antisense orientation. That is, the DNA molecule is operatively linked to a regulatory sequence in a manner which allows for expression (by transcription of the DNA molecule) of an RNA molecule which is antisense to *Streptococcus pneumoniae* mRNA. Regulatory sequences operatively linked to a nucleic acid cloned in the antisense orientation can be chosen which direct the continuous expression of the antisense RNA molecule in a variety of cell types. For instance viral promoters and/or enhancers, or regulatory sequences can be chosen which direct constitutive, tissue specific or cell type specific expression of antisense RNA. The antisense expression vector can be in the form of a recombinant plasmid, phagemid or attenuated virus in which antisense nucleic acids are produced under the control of a high efficiency regulatory region, the activity of which can be determined by the cell type into which the vector is introduced.

Another aspect of the invention pertains to host cells into which a recombinant expression vector of the invention has been introduced. The terms "host cell" and "recombinant host cell" are used interchangeably hereinafter. It is understood that such terms refer not only to the particular subject cell, but to the progeny or potential progeny of such a cell. Because certain modifications may occur in succeeding generations due to either mutation or environmental influences, such progeny may not, in fact, be identical to the parent cell, but are still included within the scope of the term as used hereinafter. A host cell can be any prokaryotic or eukaryotic cell. For example, a *Streptococcus pneumoniae* polypeptide can be expressed in bacterial cells such as *E. coli*, insect cells (such as Sf9, Sf21), yeast or mammalian cells (such as Chinese hamster ovary cells (CHO), VERO, chick embryo

fibroblasts, BHK cells or COS cells). Other suitable host cells are known to those skilled in the art.

Vector DNA is introduced into prokaryotic or eukaryotic cells *via* conventional transformation, infection or transfection techniques. As used hereinafter, the terms "transformation" and "transfection" are intended to refer to a variety of art-recognized techniques for introducing foreign nucleic acid (*e.g.*, DNA) into a host cell, including calcium phosphate or calcium chloride co-precipitation, DEAE-dextran-mediated transfection, lipofection, ultrasound or electroporation. Suitable methods for transforming or transfecting host cells can be found in Sambrook, *et al.* ("Molecular Cloning: A Laboratory Manual" 2nd, ed, Cold Spring Harbor Laboratory, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 1989), and other laboratory manuals.

A host cell of the invention, such as a prokaryotic or eukaryotic host cell in culture, can be used to produce (*i.e.*, express) a *Streptococcus pneumoniae* polypeptide. Accordingly, the invention further provides methods for producing a *Streptococcus pneumoniae* polypeptide using the host cells of the invention. In one embodiment, the method comprises culturing the host cell of invention (into which a recombinant expression vector encoding a *Streptococcus pneumoniae* polypeptide has been introduced) in a suitable medium until the *Streptococcus pneumoniae* polypeptide is produced. In another embodiment, the method further comprises isolating the *Streptococcus pneumoniae* polypeptide from the medium or the host cell.

A coding sequence of an expression vector is operatively linked to a transcription termination region. RNA polymerase transcribes an encoding DNA sequence through a site where polyadenylation occurs. Typically, DNA sequences located a few hundred base pairs downstream of the polyadenylation site serve to terminate transcription. Those DNA sequences are referred to hereinafter as transcription-termination regions. Those regions are required for efficient polyadenylation of transcribed messenger RNA (mRNA). Transcription-termination regions are well known in the art. A preferred transcription-termination region used in an adenovirus vector construct of the present invention comprises a polyadenylation signal of SV40 or the protamine gene.

An expression vector comprises a polynucleotide that encodes a *Streptococcus pneumoniae* polypeptide. Such a polypeptide is meant to include a sequence of nucleotide bases encoding a *Streptococcus pneumoniae* polypeptide sufficient in length to distinguish the segment from a polynucleotide segment encoding a non-*Streptococcus pneumoniae* polypeptide. A polypeptide of the invention can also encode biologically functional polypeptides or peptides which have variant amino acid sequences, such as with changes selected based on considerations such as the relative hydropathic score of the amino acids being exchanged. These variant sequences are those isolated from natural sources or induced in the sequences disclosed hereinafter using a mutagenic procedure such as site-directed mutagenesis.

Preferably, the expression vectors of the present invention comprise polynucleotide that encode polypeptides comprising the amino acid residue sequence of one of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752. An expression vector can include a *Streptococcus pneumoniae* polypeptide coding region itself of any of the *Streptococcus pneumoniae* polypeptides noted above or it can contain coding regions bearing selected alterations or modifications in the basic coding region of such a *Streptococcus pneumoniae* polypeptide. Alternatively, such vectors or fragments can code larger polypeptides or polypeptides which nevertheless include the basic coding region. In any event, it should be appreciated that due to codon redundancy as well as biological functional equivalence, this aspect of the invention is not limited to the particular DNA molecules corresponding to the polypeptide sequences noted above.

Exemplary vectors include the mammalian expression vectors of the pCMV family including pCMV6b and pCMV6c (Chiron Corp., Emeryville CA.). In certain cases, and specifically in the case of these individual mammalian expression vectors, the resulting constructs can require co-transfection with a vector containing a selectable marker such as pSV2neo. *Via* co-transfection into a dihydrofolate reductase-deficient Chinese hamster ovary cell line, such as DG44, clones expressing *Streptococcus pneumoniae* polypeptides by virtue of DNA incorporated into such expression vectors can be detected.

A DNA molecule of the present invention can be incorporated into a vector by a number of techniques that are well known in the art. For instance, the vector

pUC18 has been demonstrated to be of particular value in cloning and expression of genes. Likewise, the related vectors M13mp18 and M13mp19 can be used in certain embodiments of the invention, in particular, in performing dideoxy sequencing.

An expression vector of the present invention is useful both as a means for preparing quantities of the *Streptococcus pneumoniae* polypeptide-encoding DNA itself, and as a means for preparing the encoded polypeptide and peptides. It is contemplated that where *Streptococcus pneumoniae* polypeptides of the invention are made by recombinant means, one can employ either prokaryotic or eukaryotic expression vectors as shuttle systems.

In another aspect, the recombinant host cells of the present invention are prokaryotic host cells. Preferably, the recombinant host cells of the invention are bacterial cells of the DH5 α strain of *Escherichia coli*. In general, prokaryotes are preferred for the initial cloning of DNA sequences and constructing the vectors useful in the invention. For example, *E. coli* K12 strains can be particularly useful. Other microbial strains that can be used include *E. coli* B, and *E. coli*$_\chi$1976 (ATCC No. 31537). These examples are, of course, intended to be illustrative rather than limiting.

The aforementioned strains, as well as *E. coli* W3110 (ATCC No. 273325), *E. coli* BL21(DE3), *E. coli* Top10, *bacilli* such as *Bacillus subtilis*, or other enterobacteriaceae such as *Salmonella typhimurium* (or other attenuated Salmonella strains as described in U.S. Patent 4,837,151) *or Serratia marcesans,* and various Pseudomonas species can be used.

In general, plasmid vectors containing replicon and control sequences, which are derived from species compatible with the host cell are used in connection with these hosts. The vector ordinarily carries a replication site, as well as marking sequences which are capable of providing phenotypic selection in transformed cells. For example, *E. coli* can be transformed using pBR322, a plasmid derived from an *E. coli* species (Bolivar, *et al.* 1977). pBR322 contains genes for ampicillin and tetracycline resistance and thus provides easy means for identifying transformed cells. The pBR plasmid, or other microbial plasmid or phage must also contain, or be modified to contain, promoters which can be used by the microbial organism for expression of its own polypeptides.

Those promoters most commonly used in recombinant DNA construction include the β-lactamase (penicillinase) and lactose promoter systems (Chang, *et al.* 1978; Itakura., *et al.* 1977, Goeddel, *et al.* 1979; Goeddel, *et al.* 1980) and a tryptophan (TRP) promoter system (EP 0036776; Siebwenlist *et al.* 1980). While these are the most commonly used, other microbial promoters have been discovered and utilized, and details concerning their nucleotide sequences have been published, enabling a skilled worker to introduce functional promoters into plasmid vectors (Siebwenlist, *et al.* 1980).

In addition to prokaryotes, eukaryotic microbes such as yeast can also be used. *Saccharomyces cerevisiase* or common baker's yeast is the most commonly used among eukaryotic microorganisms, although a number of other strains are commonly available. For expression in Saccharomyces, the plasmid YRp7, for example, is commonly used (Stinchcomb, *et al.* 1979; Kingsman, *et al.* 1979; Tschemper, *et al.* 1980). This plasmid already contains the trpl gene which provides a selection marker for a mutant strain of yeast lacking the ability to grow in tryptophan, for example ATCC No. 44076 or PEP4-1 (Jones, 1977). The presence of the trpl lesion as a characteristic of the yeast host cell genome then provides an effective environment for detecting transformation by growth in the absence of tryptophan.

Suitable promoter sequences in yeast vectors include the promoters for 3-phosphoglycerate kinase (Hitzeman., *et al.* 1980) or other glycolytic enzymes (Hess, *et al.* 1968; Holland, *et al.* 1978) such as enolase, glyceraldehyde-3-phosphate dehydrogenase, hexokinase, pyruvate decarboxylase, phosphofructokinase, glucose-6-phosphate isomerase, 3-phosphoglycerate mutase, pyruvate kinase, triosephosphate isomerase, phosphoglucose isomerase, and glucokinase. In constructing suitable expression plasmids, the termination sequences associated with these genes are also introduced into the expression vector downstream from the sequences to be expressed to provide polyadenylation of the mRNA and termination. Other promoters, which have the additional advantage of transcription controlled by growth conditions are the promoter region for alcohol dehydrogenase 2, isocytochrome C, acid phosphatase, degradative enzymes associated with nitrogen metabolism, and the aforementioned glyceraldehyde-3-phosphate dehydrogenase, and enzymes responsible for maltose and galactose utilization. Any plasmid vector

containing a yeast-compatible promoter, origin or replication and termination sequences are suitable.

In addition to microorganisms, cultures of cells derived from multicellular organisms can also be used as hosts. In principle, any such cell culture is workable, whether from vertebrate or invertebrate culture. However, interest has been greatest in vertebrate cells, and propagation of vertebrate cells in culture (tissue culture) has become a routine procedure in recent years. Examples of such useful host cell lines are AtT-20, VERO, HeLa, NSO, PER C6, Chinese hamster ovary (CHO) cell lines, and W138, BHK, COSM6, COS-7, 293 and MDCK cell lines. Expression vectors for such cells ordinarily include (if necessary) an origin of replication, a promoter located upstream of the gene to be expressed, along with any necessary ribosome binding sites, RNA splice sites, polyadenylation site, and transcriptional terminator sequences.

Where expression of recombinant *Streptococcus pneumoniae* polypeptides is desired and a eukaryotic host is contemplated, it is most desirable to employ a vector such as a plasmid, that incorporates a eukaryotic origin of replication. Additionally, for the purposes of expression in eukaryotic systems, one desires to position the *Streptococcus pneumoniae* encoding sequence adjacent to and under the control of an effective eukaryotic promoter such as promoters used in combination with Chinese hamster ovary cells. To bring a coding sequence under control of a promoter, whether it is eukaryotic or prokaryotic, the 5' end of the translation initiation region of the proper translational reading frame of the polypeptide must be positioned between about 1 and about 50 nucleotides 3' of or downstream with respect to the promoter chosen. Furthermore, where eukaryotic expression is anticipated, one would typically desire to incorporate into the transcriptional unit which includes the *Streptococcus pneumoniae* polypeptide.

Means of transforming or transfecting cells with exogenous polynucleotide such as DNA molecules are well known in the art and include techniques such as calcium-phosphate- or DEAE-dextran-mediated transfection, protoplast fusion, electroporation, liposome mediated transfection, direct microinjection and adenovirus infection (*see e.g.*, Sambrook, Fritsch and Maniatis, 1989).

The most widely used method is transfection mediated by either calcium phosphate or DEAE-dextran. Although the mechanism remains obscure, it is

believed that the transfected DNA enters the cytoplasm of the cell by endocytosis and is transported to the nucleus. Depending on the cell type, up to 90% of a population of cultured cells can be transfected at any one time. Because of its high efficiency, transfection mediated by calcium phosphate or DEAE-dextran is the method of choice for experiments that require transient expression of the foreign DNA in large numbers of cells. Calcium phosphate-mediated transfection is also used to establish cell lines that integrate copies of the foreign DNA, which are usually arranged in head-to-tail tandem arrays into the host cell genome.

In the protoplast fusion method, protoplasts derived from bacteria carrying high numbers of copies of a plasmid of interest are mixed directly with cultured mammalian cells. After fusion of the cell membranes (usually with polyethylene glycol), the contents of the bacteria are delivered into the cytoplasm of the mammalian cells and the plasmid DNA is transported to the nucleus. Protoplast fusion is not as efficient as transfection for many of the cell lines that are commonly used for transient expression assays, but it is useful for cell lines in which endocytosis of DNA occurs inefficiently. Protoplast fusion frequently yields multiple copies of the plasmid DNA tandemly integrated into the host chromosome.

The application of brief, high-voltage electric pulses to a variety of mammalian and plant cells leads to the formation of nanometer-sized pores in the plasma membrane. DNA is taken directly into the cell cytoplasm either through these pores or as a consequence of the redistribution of membrane components that accompanies closure of the pores. Electroporation can be extremely efficient and can be used both for transient expression of cloned genes and for establishment of cell lines that carry integrated copies of the gene of interest. Electroporation, in contrast to calcium phosphate-mediated transfection and protoplast fusion, frequently gives rise to cell lines that carry one, or at most a few, integrated copies of the foreign DNA.

Liposome transfection involves encapsulation of DNA and RNA within liposomes, followed by fusion of the liposomes with the cell membrane. The mechanism of how DNA is delivered into the cell is unclear but transfection efficiencies can be as high as 90%.

Direct microinjection of a DNA molecule into nuclei has the advantage of not exposing DNA to cellular compartments such as low-pH endosomes. Microinjection

is therefore used primarily as a method to establish lines of cells that carry integrated copies of the DNA of interest.

The use of adenovirus as a vector for cell transfection is well known in the art. Adenovirus vector-mediated cell transfection has been reported for various cells (Stratford-Perricaudet, *et al.* 1992).

A transfected cell can be prokaryotic or eukaryotic. Preferably, the host cells of the invention are prokaryotic host cells. Where it is of interest to produce a *Streptococcus pneumoniae* polypeptide, cultured prokaryotic host cells are of particular interest.

In yet another embodiment, the present invention contemplates a process or method of preparing *Streptococcus pneumoniae* polypeptides comprising transforming, transfecting or infecting cells with a polynucleotide that encodes a *Streptococcus pneumoniae* polypeptide to produce transformed host cells; and maintaining the transformed host cells under biological conditions sufficient for expression of the polypeptide. Preferably, the transformed host cells are prokaryotic cells. Alternatively, the host cells are eukaryotic cells. More preferably, the prokaryotic cells are bacterial cells of the DH5-α strain of *Escherichia coli*. Even more preferably, the polynucleotide transfected into the transformed cells comprise the nucleic acid sequence of one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591. Additionally, transfection is accomplished using an expression vector disclosed above. A host cell used in the process is capable of expressing a functional, recombinant *Streptococcus pneumoniae* polypeptide.

Following transfection, the cell is maintained under culture conditions for a period of time sufficient for expression of a *Streptococcus pneumoniae* polypeptide. Culture conditions are well known in the art and include ionic composition and concentration, temperature, pH and the like. Typically, transfected cells are maintained under culture conditions in a culture medium. Suitable media for various cell types are well known in the art. In a preferred embodiment, temperature is from about 20°C to about 50°C, more preferably from about 30°C to about 40°C and, even more preferably about 37°C.

The pH is preferably from about a value of 6.0 to a value of about 8.0, more preferably from about a value of about 6.8 to a value of about 7.8 and, most preferably about 7.4. Osmolality is preferably from about 200 milliosmols per liter

(mosm/L) to about 400 mosm/l and, more preferably from about 290 mosm/L to about 310 mosm/L. Other biological conditions needed for transfection and expression of an encoded protein are well known in the art.

Transfected cells are maintained for a period of time sufficient for expression of an *Streptococcus pneumoniae* polypeptide. A suitable time depends *inter alia* upon the cell type used and is readily determinable by a skilled artisan. Typically, maintenance time is from about 2 to about 14 days.

Recombinant *Streptococcus pneumoniae* polypeptide is recovered or collected either from the transfected cells or the medium in which those cells are cultured. Recovery comprises isolating and purifying the *Streptococcus pneumoniae* polypeptide. Isolation and purification techniques for polypeptides are well known in the art and include such procedures as precipitation, filtration, chromatography, electrophoresis and the like.

F. ANTIBODIES IMMUNOREACTIVE WITH STREPTOCOCCUS PNEUMONIAE POLYPEPTIDES

In still another embodiment, the present invention provides antibodies immunoreactive with *Streptococcus pneumoniae* polypeptides. Preferably, the antibodies of the invention are monoclonal antibodies. Additionally, the *Streptococcus pneumoniae* polypeptides comprise the amino acid residue sequence of one of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752. Means for preparing and characterizing antibodies are well known in the art (*See, e.g.*, Antibodies "A Laboratory Manual", E. Harlow and D. Lane, Cold Spring Harbor Laboratory, 1988).

Briefly, a polyclonal antibody is prepared by immunizing an animal with an immunogen comprising a polypeptide or polynucleotide of the present invention, and collecting antisera from that immunized animal. A wide range of animal species can be used for the production of antisera. Typically an animal used for production of anti-antisera is a rabbit, a mouse, a rat, a hamster or a guinea pig. Because of the relatively large blood volume of rabbits, a rabbit is a preferred choice for production of polyclonal antibodies.

As is well known in the art, a given polypeptide or polynucleotide may vary in its immunogenicity. It is often necessary therefore to couple the immunogen (*e.g.*, a

polypeptide or polynucleotide) of the present invention with a carrier. Exemplary and preferred carriers are CRM_{197}, keyhole limpet hemocyanin (KLH) and bovine serum albumin (BSA). Other albumins such as ovalbumin, mouse serum albumin or rabbit serum albumin can also be used as carriers.

Means for conjugating a polypeptide or a polynucleotide to a carrier protein are well known in the art and include glutaraldehyde, m-maleimidobencoyl-N-hydroxysuccinimide ester, carbodiimide and bis-biazotized benzidine.

The amount of immunogen used for the production of polyclonal antibodies varies *inter alia*, upon the nature of the immunogen as well as the animal used for immunization. A variety of routes can be used to administer the immunogen (subcutaneous, intramuscular, intradermal, intravenous and intraperitoneal). The production of polyclonal antibodies is monitored by sampling blood of the immunized animal at various points following immunization. When a desired level of immunogenicity is obtained, the immunized animal can be bled and the serum isolated and stored.

In another aspect, the present invention contemplates a process of producing an antibody immunoreactive with a *Streptococcus pneumoniae* polypeptide comprising the steps of (a) transfecting recombinant host cells with a polynucleotide that encodes a *Streptococcus pneumoniae* polypeptide; (b) culturing the host cells under conditions sufficient for expression of the polypeptide; (c) recovering the polypeptides; and (d) preparing the antibodies to the polypeptides. Preferably, the host cell is transfected with the polynucleotide of one of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591. Even more preferably, the present invention provides antibodies prepared according to the process described above.

A monoclonal antibody of the present invention can be readily prepared through use of well-known techniques such as those exemplified in U.S. Patent 4,196,265, hereinafter incorporated by reference. Typically, a technique involves first immunizing a suitable animal with a selected antigen (*e.g.*, a polypeptide or polynucleotide of the present invention) in a manner sufficient to provide an immune response. Rodents, such as mice and rats, are preferred animals. Spleen cells from the immunized animal are then fused with cells of an immortal myeloma cell. Where

the immunized animal is a mouse, a preferred myeloma cell is a murine NS-1 myeloma cell.

The fused spleen/myeloma cells are cultured in a selective medium to select fused spleen/myeloma cells from the parental cells. Fused cells are separated from the mixture of non-fused parental cells, *e.g.*, by the addition of agents that block the *de novo* synthesis of nucleotides in the tissue culture media. Exemplary and preferred agents are aminopterin, methotrexate, and azaserine. Aminopterin and methotrexate block *de novo* synthesis of both purines and pyrimidines, whereas azaserine blocks only purine synthesis. Where aminopterin or methotrexate is used, the media is supplemented with hypoxanthine and thymidine as a source of nucleotides. Where azaserine is used, the media is supplemented with hypoxanthine.

This culturing provides a population of hybridomas from which specific hybridomas are selected. Typically, selection of hybridomas is performed by culturing the cells by single-clone dilution in microtiter plates, followed by testing the individual clonal supernatants for reactivity with an antigen-polypeptide. The selected clones can then be propagated indefinitely to provide the monoclonal antibody.

By way of specific example, to produce an antibody of the present invention, mice are injected intraperitoneally with between about 1-200 μg of an antigen comprising a polypeptide of the present invention. B lymphocyte cells are stimulated to grow by injecting the antigen in association with an adjuvant such as complete Freund's adjuvant (a non-specific stimulator of the immune response containing killed Mycobacterium tuberculosis). At some time (*e.g.*, at least two weeks) after the first injection, mice are boosted by injection with a second dose of the antigen mixed with incomplete Freund's adjuvant.

A few weeks after the second injection, mice are tail bled and the sera titered by immunoprecipitation against radiolabeled antigen. Preferably, the process of boosting and titering is repeated until a suitable titer is achieved. The spleen of the mouse with the highest titer is removed and the spleen lymphocytes are obtained by homogenizing the spleen with a syringe. Typically, a spleen from an immunized mouse contains approximately $5x10^7$ to $2x10^8$ lymphocytes.

Mutant lymphocyte cells known as myeloma cells are obtained from laboratory animals in which such cells have been induced to grow by a variety of well-known methods. Myeloma cells lack the salvage pathway of nucleotide biosynthesis. Because myeloma cells are tumor cells, they can be propagated indefinitely in tissue culture, and are thus denominated immortal. Numerous cultured cell lines of myeloma cells from mice and rats, such as murine NS-1 myeloma cells, have been established.

Myeloma cells are combined under conditions appropriate to foster fusion with the normal antibody-producing cells from the spleen of the mouse or rat injected with the antigen/polypeptide of the present invention. Fusion conditions include, for example, the presence of polyethylene glycol. The resulting fused cells are hybridoma cells. Like myeloma cells, hybridoma cells grow indefinitely in culture.

Hybridoma cells are separated from unfused myeloma cells by culturing in a selection medium such as HAT media (hypoxanthine, aminopterin, thymidine). Unfused myeloma cells lack the enzymes necessary to synthesize nucleotides from the salvage pathway because they are killed in the presence of aminopterin, methotrexate, or azaserine. Unfused lymphocytes also do not continue to grow in tissue culture. Thus, only cells that have successfully fused (hybridoma cells) can grow in the selection media.

Each of the surviving hybridoma cells produces a single antibody. These cells are then screened for the production of the specific antibody immunoreactive with an antigen/polypeptide of the present invention. Single cell hybridomas are isolated by limiting dilutions of the hybridomas. The hybridomas are serially diluted many times and, after the dilutions are allowed to grow, the supernatant is tested for the presence of the monoclonal antibody. The clones producing that antibody are then cultured in large amounts to produce an antibody of the present invention in convenient quantity.

By use of a monoclonal antibody of the present invention, specific polypeptides and polynucleotide of the invention are identified as antigens. Once identified, those polypeptides and polynucleotides are isolated and purified by techniques such as antibody-affinity chromatography. In antibody-affinity chromatography, a monoclonal antibody is bound to a solid substrate and exposed to a solution containing the desired antigen. The antigen is removed from the solution

through an immunospecific reaction with the bound antibody. The polypeptide or polynucleotide is then easily removed from the substrate and purified.

Additionally, examples of methods and reagents particularly amenable for use in generating and screening antibody display library can be found in, for example, U.S. Patent 5,223,409; International Application WO 92/18619; International Application WO 91/17271; International Application WO 92/20791; International Application WO 92/15679; International Application WO 93/01288; International Application WO 92/01047; International Application WO 92/09690; International Application WO 90/02809.

Additionally, recombinant anti-*Streptococcus pneumoniae* antibodies, such as chimeric and humanized monoclonal antibodies, comprising both human and non-human fragments, which can be made using standard recombinant DNA techniques, are within the scope of the invention. Such chimeric and humanized monoclonal antibodies can be produced by recombinant DNA techniques known in the art, for example using methods described in International Application PCT/US86/02269; International Application EP 184,187; International Application EP 171,496; International Application EP 173,494; International Application WO 86/01533; U.S. Patent 4,816,567; and International Application EP 125,023.

An anti-*Streptococcus pneumoniae* antibody (*e.g.*, monoclonal antibody) is used to isolate *Streptococcus pneumoniae* polypeptides by standard techniques, such as affinity chromatography or immunoprecipitation. An anti-*Streptococcus pneumoniae* antibody facilitates the purification of a natural *Streptococcus pneumoniae* polypeptide from cells and recombinantly produced *Streptococcus pneumoniae* polypeptides expressed in host cells. Moreover, an anti-*Streptococcus pneumoniae* antibody is used to detect *Streptococcus pneumoniae* polypeptide (*e.g.*, in a cellular lysate or cell supernatant) in order to evaluate the abundance of the *Streptococcus pneumoniae* polypeptide. The detection of circulating fragments of a *Streptococcus pneumoniae* polypeptide is used to identify *Streptococcus pneumoniae* polypeptide turnover in a subject. Anti-*Streptococcus pneumoniae* antibodies are used diagnostically to monitor protein levels in tissue as part of a clinical testing procedure, *e.g.*, to, for example, determine the efficacy of a given treatment regimen. Detection is facilitated by coupling (*i.e.*, physically linking) the antibody to a detectable substance. Examples of detectable substances include

various enzymes, prosthetic groups, fluorescent materials, luminescent materials, bioluminescent materials, and radioactive materials. Examples of suitable enzymes include horseradish peroxidase, alkaline phosphatase, P-galactosidase, or acetylcholinesterase; examples of suitable prosthetic group complexes include streptavidin/biotin and avidin/biotin; examples of suitable fluorescent materials include umbelliferone, fluorescein, fluorescein isothiocyanate, rhodamine, dichlorotriazinylamine fluorescein, dansyl chloride or phycoerythrin; an example of a luminescent material includes luminol; examples of bioluminescent materials include luciferase, luciferin, and acquorin, and examples of suitable radioactive material include ^{125}I, ^{131}I, ^{15}S or ^{3}H.

G. PHARMACEUTICAL AND IMMUNOGENIC COMPOSITIONS

In certain embodiments, the present invention provides pharmaceutical and immunogenic compositions comprising *Streptococcus pneumoniae* polypeptides and physiologically acceptable carriers. More preferably, the pharmaceutical compositions comprise one or more *Streptococcus pneumoniae* polypeptides comprising the amino acid residue sequence of one or more of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752. In other embodiments, the pharmaceutical compositions of the invention comprise polynucleotides that encode *Streptococcus pneumoniae* polypeptides, and physiologically acceptable carriers. Preferably, the pharmaceutical and immunogenic compositions of the present invention comprise *Streptococcus pneumoniae* polypeptides comprising the amino acid sequence of one of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752. Alternatively, the pharmaceutical and immunogenic compositions comprise polynucleotides comprising the nucleotide sequence of one of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591.

Various tests are used to assess the *in vitro* immunogenicity of the polypeptides of the invention. For example, an *in vitro* opsonic assay is conducted by incubating together a mixture of *Streptococcus pneumoniae* cells, heat inactivated human serum containing specific antibodies to the polypeptide in question, and an exogenous complement source. Opsonophagocytosis proceeds during incubation of freshly isolated human polymorphonuclear cells (PMN's) and the

antibody/complement/pneumococcal cell mixture. Bacterial cells that are coated with antibody and complement are killed upon opsonophagocytosis. Colony forming units (cfu) of surviving bacteria that escape from opsonophagocytosis are determined by plating the assay mixture. Titers are reported as the reciprocal of the highest dilution that gives $\geq$ 50% bacterial killing, as determined by comparison to assay controls. Specimens which demonstrate less than 50% killing at the lowest serum dilution tested (1:8), are reported as having an OPA titer of 4. The highest dilution tested is 1:2560. Samples with $\geq$ 50% killing at the highest dilution are repeated, beginning with a higher initial dilution. The method described above is a modification of Gray's method (Gray, 1990).

A test serum control, which contains test serum plus bacterial cells and heat inactivated complement, is included for each individual serum. This control can be used to assess whether the presence of antibiotics or other serum components are capable of killing the bacterial strain directly (*i.e.* in the absence of complement or PMN's). A human serum with known opsonic titer is used as a positive human serum control. The opsonic antibody titer for each unknown serum can be calculated as the reciprocal of the initial dilution of serum giving 50% cfu reduction compared to the control without serum.

A whole cell ELISA assay is also used to assess *in vitro* immunogenicity and surface exposure of the polypeptide antigen, wherein the bacterial strain of interest (*S. pneumoniae*) is coated onto a plate, such as a 96 well plate, and test sera from an immunized animal is reacted with the bacterial cells. If any antibody, specific for the test polypeptide antigen, is reactive with a surface exposed epitope of the polypeptide antigen, it can be detected by standard methods known to one skilled in the art.

Any polypeptide demonstrating the desired *in vitro* activity is then tested in an *in vivo* animal challenge model. In certain embodiments, immunogenic compositions are used in the immunization of an animal (*e.g.*, a mouse) by methods and routes of immunization known to those of skill in the art (*e.g.*, intranasal, parenteral, oral, rectal, vaginal, transdermal, intraperitoneal, intravenous, subcutaneous, *etc.*). Following immunization of the animal with a particular *Streptococcus pneumoniae* immunogenic composition, the animal is challenged with *Streptococcus pneumoniae* and assayed for resistance to *Streptococcus pneumoniae* infection.

In one embodiment, six-week old, pathogen-free, Balb/c mice are immunized and challenged with *Streptococcus pneumoniae*. For example, BALB/C mice, at 10 animals per group, are immunized (by slow instillation into the nostrils of each mouse) with one or more doses of the desired polypeptide in an immunogenic composition. *Streptococcus pneumoniae* colonizes the nasopharynx of Balb/c mice, but does not cause disease or death. Subsequently, the Balb/c mice are challenged with streptomycin-resistant *Streptococcus pneumoniae*. The Balb/c mice are sacrificed post-challenge, the noses removed, and homogenized in sterile saline. The homogenate is diluted in saline and plated on streptomycin-containing TSA plates. Plates are incubated overnight at 37°C and then colonies are counted. Statistically significant reduction of nasopharyngeal colonization indicates that the polypeptide is suitable for use in human clinical trials.

In another embodiment, six-week old, pathogen-free, male CBA/CaHN xid/J (CBA/N) mice are immunized intranasally or parenterally prior to *Streptococcus pneumoniae* challenge. CBA/N mice, at 10 animals per group, are immunized with an appropriate amount of the desired polypeptide in an immunogenic composition to be tested. CBA/N mice are immunodeficient (XID) and, when challenged with appropriate *Streptococcus pneumoniae*, develop nasopharyngeal colonization, bacteremia and death.

The CBA/N mice are immunized intranasally or subcutaneously with one or more doses of the desired immunogenic composition. Subsequently, the CBA/N mice are challenged with streptomycin-resistant *Streptococcus pneumoniae*. To determine the effects of immunization on intranasal colonization, the CBA/N mice are sacrificed post-challenge, the noses are removed, and homogenized in sterile saline. The homogenate is serially diluted in saline and plated on streptomycin-containing TSA plates. In addition, blood collected post-challenge from each mouse is also plated on streptomycin-containing TSA plates to determine levels of bacteremia. Plates are incubated overnight at 37°C and then colonies are counted. In another embodiment, CBA/N mice are immunized as described above and challenged intranasally. The CBA/N mice are observed daily after challenge, and the mortality is monitored for 14 days. Statistically significant reduction of nasopharyngeal colonization and/or mortality indicates that the polypeptide is suitable for use in human clinical trials.

The *Streptococcus pneumoniae* polynucleotides, polypeptides, modulators of a *Streptococcus pneumoniae* polypeptides, and anti-*Streptococcus pneumoniae* antibodies (also referred to hereinafter as "active compounds") of the invention are incorporated into pharmaceutical and immunogenic compositions suitable for administration to a subject, *e.g.*, a human. Such compositions typically comprise the nucleic acid molecule, protein, modulator, or antibody and a pharmaceutically acceptable carrier. As used hereinafter the language "pharmaceutically acceptable carrier" is intended to include any and all solvents, dispersion media, coatings, antibacterial and antifungal agents, isotonic and absorption delaying agents, and the like, compatible with pharmaceutical administration. The use of such media and agents for pharmaceutically active substances is well known in the art. Except insofar as any conventional media or agent is incompatible with the active compound, such media can be used in the compositions of the invention. Supplementary active compounds can also be incorporated into the compositions.

A pharmaceutical or immunogenic composition of the invention is formulated to be compatible with its intended route of administration. Examples of routes of administration include parenteral (*e.g.*, intravenous, intradermal, subcutaneous, intraperitoneal), transmucosal (e.g., oral, rectal, intranasal, vaginal, respiratory) and transdermal (topical). Solutions or suspensions used for parenteral, intradermal, or subcutaneous application can include the following components: a sterile diluent such as water for injection, saline solution, fixed oils, polyethylene glycols, glycerine, propylene glycol or other synthetic solvents; antibacterial agents such as benzyl alcohol or methyl parabens; antioxidants such as ascorbic acid or sodium bisulfite; chelating agents such as ethylenediaminetetraacetic acid; buffers such as acetates, citrates or phosphates and agents for the adjustment of tonicity such as sodium chloride or dextrose. pH can be adjusted with acids or bases, such as hydrochloric acid or sodium hydroxide. The parenteral preparation can be enclosed in ampoules, disposable syringes or multiple dose vials made of glass or plastic.

Pharmaceutical compositions suitable for injectable use include sterile aqueous solutions (where water soluble) or dispersions and sterile powders for the extemporaneous preparation of sterile injectable solutions or dispersion. For intravenous administration, suitable carriers include physiological saline, bacteriostatic water, Cremophor ELTM(BASF, Parsippany, NJ) or phosphate

buffered saline (PBS). In all cases, the composition must be sterile and should be fluid to the extent that easy syringability exists. It must be stable under the conditions of manufacture and storage and must be preserved against the contaminating action of microorganisms such as bacteria and fungi. The carrier can be a solvent or dispersion medium containing, for example, water, ethanol, polyol (for example, glycerol, propylene glycol, and liquid polyetheylene glycol, and the like), and suitable mixtures thereof. The proper fluidity can be maintained, for example, by the use of a coating such as lecithin, by the maintenance of the required particle size in the case of dispersion and by the use of surfactants. Prevention of the action of microorganisms can be achieved by various antibacterial and antifungal agents, for example, parabens, chlorobutanol, phenol, ascorbic acid, thimerosal, and the like. In many cases, it will be preferable to include isotonic agents, for example, sugars, polyalcohols such as manitol, sorbitol, sodium chloride in the composition. Prolonged absorption of the injectable compositions can be brought about by including in the composition an agent which delays absorption; for example, aluminum monostearate and gelatin.

Sterile injectable solutions can be prepared by incorporating the active compound (*e.g.*, a *Streptococcus pneumoniae* polypeptide or anti-*Streptococcus pneumoniae* antibody) in the required amount in an appropriate solvent with one or a combination of ingredients enumerated above, as required, followed by filtered sterilization. Generally, dispersions are prepared by incorporating the active compound into a sterile vehicle which contains a basic dispersion medium and the required other ingredients from those enumerated above. In the case of sterile powders for the preparation of sterile injectable solutions, the preferred methods of preparation are vacuum drying and freeze-drying which yields a powder of the active ingredient plus any additional desired ingredient from a previously sterile-filtered solution thereof.

Oral compositions generally include an inert diluent or an edible carrier. They can be enclosed in gelatin capsules or compressed into tablets. For the purpose of oral therapeutic administration, the active compound can be incorporated with excipients and used in the form of tablets, troches, or capsules. Oral compositions can also be prepared using a fluid carrier for use as a mouthwash, wherein the compound in the fluid carrier is applied orally and swished and expectorated or

swallowed. Pharmaceutically compatible binding agents, and/or adjuvant materials can be included as part of the composition. The tablets, pills, capsules, troches and the like can contain any of the following ingredients, or compounds of a similar nature: a binder such as microcrystalline cellulose, gum tragacanth or gelatin; an excipient such as starch or lactose, a disintegrating agent such as alginic acid, Primogel, or corn starch; a lubricant such as magnesium stearate or Sterotes; a glidant such as colloidal silicon dioxide; a sweetening agent such as sucrose or saccharin; or a flavoring agent such as peppermint, methyl salicylate, or orange flavoring.

For administration by inhalation, the compounds are delivered in the form of an aerosol spray from pressured container or dispenser which contains a suitable propellant, *e.g.*, a gas such as carbon dioxide, or a nebulizer. Systemic administration can also be by transmucosal or transdermal means. For transmucosal or transdermal administration, penetrants appropriate to the barrier to be permeated are used in the formulation. Such penetrants are generally known in the art, and include, for example, for transmucosal administration, detergents, bile salts, and fusidic acid derivatives. Transmucosal administration can be accomplished through the use of nasal sprays or suppositories. For transdermal administration, the active compounds are formulated into ointments, salves, gels, or creams as generally known in the art.

The compounds can also be prepared in the form of suppositories (*e.g.*, with conventional suppository bases such as cocoa butter and other glycerides) or retention enemas for rectal delivery.

In one embodiment, the active compounds are prepared with carriers that will protect the compound against rapid elimination from the body, such as a controlled release formulation, including implants and microencapsulated delivery systems.

Biodegradable, biocompatible polymers can be used, such as ethylene vinyl acetate, polyanhydrides, polyglycolic acid, collagen, polyorthoesters, and polylactic acid. Methods for preparation of such formulations will be apparent to those skilled in the art. The materials can also be obtained commercially from Alza Corporation and Nova Pharmaceuticals, Inc. Liposomal suspensions (including liposomes targeted to infected cells with monoclonal antibodies to viral antigens) can also be used as pharmaceutically acceptable carriers. These can be prepared according to methods

known to those skilled in the art, for example, as described in U.S. Patent 4,522,811 which is incorporated hereinafter by reference.

It is especially advantageous to formulate oral or parenteral compositions in dosage unit form for ease of administration and uniformity of dosage. Dosage unit form as used hereinafter refers to physically discrete units suited as unitary dosages for the subject to be treated; each unit containing a predetermined quantity of active compound calculated to produce the desired therapeutic effect in association with the required pharmaceutical carrier. The specification for the dosage unit forms of the invention are dictated by and directly dependent on the unique characteristics of the active compound and the particular therapeutic effect to be achieved, and the limitations inherent in the art of compounding such an active compound for the treatment of individuals.

Combination immunogenic compositions are provided by including two or more of the polypeptides of the invention, as well as by combining one or more of the polypeptides of the invention with one or more known *S. pyogenes* polypeptides, including, but not limited to, the C5a peptidase, the M proteins, adhesins and the like.

In other embodiments, combination immunogenic compositions are provided by combining one or more of the polypeptides of the invention with one or more known *S. pneumoniae* polysaccharides or polysaccharide-protein conjugates, including, but not limited to, the currently available 23-valent pneumococcal capsular polysaccharide vaccine and the 7-valent pneumococcal polysaccharide-protein conjugate vaccine.

The nucleic acid molecules of the invention are inserted into a variety of vectors and expression systems. A great variety of expression systems are used. Such systems include, among others, chromosomal, episomal and virus-derived systems, *e.g.*, vectors derived from bacterial plasmids, attenuated bacteria such as Salmonella (U.S. Patent 4,837,151) from bacteriophage, from transposons, from yeast episomes, from insertion elements, from yeast chromosomal elements, from viruses such as vaccinia and other poxviruses, sindbis, adenovirus, baculoviruses, papova viruses, such as SV40, fowl pox viruses, pseudorabies viruses and retroviruses, alphaviruses such as Venezuelan equine encephalitis virus (U.S. Patent 5,643,576), nonsegmented negative-stranded RNA viruses such as vesicular stomatitis virus (U.S. Patent 6,168,943), and vectors derived from combinations

thereof, such as those derived from plasmid and bacteriophage genetic elements, such as cosmids and phagemids. The expression systems should include control regions that regulate as well as engender expression, such as promoters and other regulatory elements (such as a polyadenylation signal). Generally, any system or vector suitable to maintain, propagate or express polynucleotides to produce a polypeptide in a host may be used. The appropriate nucleotide sequence may be inserted into an expression system by any of a variety of well-known and routine techniques, such as, for example, those set forth in Sambrook *et al.*, "Molecular Cloning: A Laboratory Manual" 2nd, ed, Cold Spring Harbor Laboratory, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY, 1989.

A pharmaceutically acceptable vehicle is understood to designate a compound or a combination of compounds entering into a pharmaceutical or immunogenic composition which does not cause side effects and which makes it possible, for example, to facilitate the administration of the active compound, to increase its life and/or its efficacy in the body, to increase its solubility in solution or alternatively to enhance its preservation. These pharmaceutically acceptable vehicles are well known and will be adapted by persons skilled in the art according to the nature and the mode of administration of the active compound chosen.

As defined hereinafter, an "adjuvant" is a substance that serves to enhance the immunogenicity of an "antigen" or the immunogenic compositions comprising a polypeptide antigens having an amino acid sequence chosen from one of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752. Thus, adjuvants are often given to boost the immune response and are well known to the skilled artisan. Examples of adjuvants contemplated in the present invention include, but are not limited to, aluminum salts (alum) such as aluminum phosphate and aluminum hydroxide, *Mycobacterium tuberculosis*, *Bordetella pertussis*, bacterial lipopolysaccharides, aminoalkyl glucosamine phosphate compounds (AGP), or derivatives or analogs thereof, which are available from Corixa (Hamilton, MT), and which are described in United States Patent Number 6,113,918; one such AGP is 2-[(R)-3-Tetradecanoyloxytetradecanoylamino]ethyl 2-Deoxy-4-O-phosphono-3-O-[(R)-3-tetradecanoyoxytetradecanoyl]-2-[(R)-3-tetradecanoyoxytetradecanoylamino]-b-D-glucopyranoside, which is also known as 529 (formerly known as RC529), which is formulated as an aqueous form or as a stable emulsion, MPL™ (3-O-deacylated

monophosphoryl lipid A) (Corixa) described in U.S. Patent Number 4,912,094, synthetic polynucleotides such as oligonucleotides containing a CpG motif (U.S. Patent Number 6,207,646), polypeptides, saponins such as Quil A or STIMULON™ QS-21 (Antigenics, Framingham, Massachusetts), described in U.S. Patent Number 5,057,540, a pertussis toxin (PT), or an E. coli heat-labile toxin (LT), particularly LT-K63, LT-R72, CT-S109, PT-K9/G129; *see, e.g.*, International Patent Publication Nos. WO 93/13302 and WO 92/19265, cholera toxin (either in a wild-type or mutant form, *e.g.*, wherein the glutamic acid at amino acid position 29 is replaced by another amino acid, preferably a histidine, in accordance with published International Patent Application number WO 00/18434). Various cytokines and lymphokines are suitable for use as adjuvants. One such adjuvant is granulocyte-macrophage colony stimulating factor (GM-CSF), which has a nucleotide sequence as described in U.S. Patent Number 5,078,996. A plasmid containing GM-CSF cDNA has been transformed into *E. coli* and has been deposited with the American Type Culture Collection (ATCC), 1081 University Boulevard, Manassas, VA 20110-2209, under Accession Number 39900. The cytokine Interleukin-12(IL-12) is another adjuvant which is described in U.S. Patent Number 5,723,127. Other cytokines or lymphokines have been shown to have immune modulating activity, including, but not limited to, the interleukins 1-alpha, 1-beta, 2, 4, 5,6, 7, 8, 10, 13, 14, 15, 16, 17 and 18, the interferons-alpha, beta and gamma, granulocyte colony stimulating factor, and the tumor necrosis factors alpha and beta, and are suitable for use as adjuvants.

A composition of the present invention is typically administered parenterally in dosage unit formulations containing standard, well-known nontoxic physiologically acceptable carriers, adjuvants, and vehicles as desired. The term parenteral as used hereinafter includes intravenous, intra-muscular, intraarterial injection, or infusion techniques.

Injectable preparations, for example sterile injectable aqueous or oleaginous suspensions, are formulated according to the known art using suitable dispersing or wetting agents and suspending agents. The sterile injectable preparation can also be a sterile injectable solution or suspension in a nontoxic parenterally acceptable diluent or solvent, for example, as a solution in 1,3-butanediol.

Among the acceptable vehicles and solvents that may be employed are water, Ringer's solution, and isotonic sodium chloride solution. In addition, sterile,

fixed oils are conventionally employed as a solvent or suspending medium. For this purpose any bland fixed oil can be employed including synthetic mono- or diglycerides. In addition, fatty acids such as oleic acid find use in the preparation of injectables.

Preferred carriers include neutral saline solutions buffered with phosphate, lactate, Tris, and the like. Of course, when administering viral vectors, one purifies the vector sufficiently to render it essentially free of undesirable contaminants, such as defective interfering adenovirus particles or endotoxins and other pyrogens such that it does not cause any untoward reactions in the individual receiving the vector construct. A preferred means of purifying the vector involves the use of buoyant density gradients, such as cesium chloride gradient centrifugation.

A carrier can also be a liposome. Means for using liposomes as delivery vehicles are well known in the art (*see, e.g.* Gabizon *et al.*, 1990; Ferruti *et al.*, 1986; and Ranade, 1989).

The immunogenic compositions of this invention also comprise a polynucleotide sequence of this invention operatively associated with a regulatory sequence that controls gene expression. The polynucleotide sequence of interest is engineered into an expression vector, such as a plasmid, under the control of regulatory elements which will promote expression of the DNA, that is, promoter and/or enhancer elements. In a preferred embodiment, the human cytomegalovirus immediate-early promoter/enhancer is used (U.S. Patent 5,168,062). The promoter may be cell-specific and permit substantial transcription of the polynucleotide only in predetermined cells.

The polynucleotide is introduced directly into the host either as "naked" DNA (U.S. Patent 5,580,859) or formulated in compositions with agents which facilitate immunization, such as bupivicaine and other local anesthetics (U.S. Patent 5,593,972) and cationic polyamines (U.S. Patent 6,127,170).

In this polynucleotide immunization procedure, the polypeptides of the invention are expressed on a transient basis *in vivo*; no genetic material is inserted or integrated into the chromosomes of the host. This procedure is to be distinguished from gene therapy, where the goal is to insert or integrate the genetic material of interest into the chromosome. An assay is used to confirm that the polynucleotides

administered by immunization do not give rise to a transformed phenotype in the host (U.S. Patent 6,168,918).

H. USES AND METHODS OF THE INVENTION

The *Streptococcus pneumoniae* polynucleotides, polypeptides, polypeptide homologues, modulators, adjuvants, and antibodies described in this invention can be used in methods of treatment, diagnostic assays particularly in disease identification, drug screening assays and monitoring of effects during clinical trials. The isolated polynucleotides of the invention can be used to express *Streptococcus pneumoniae* polypeptides (*e.g., via* a recombinant expression vector in a host cell or in polynucleotide immunization applications) and to detect *Streptococcus pneumoniae* mRNA (*e.g.*, in a biological sample). Moreover, the anti-*Streptococcus pneumoniae* antibodies of the invention can be used to detect and isolate a *Streptococcus pneumoniae* polypeptide, particularly fragments of a *Streptococcus pneumoniae* polypeptides present in a biological sample, and to modulate *Streptococcus pneumoniae* polypeptide activity.

The invention provides immunogenic compositions comprising polypeptides having an amino acid sequence chosen from one of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof or a fragment thereof. The immunogenic composition may further comprise a pharmaceutically acceptable carrier, as outlined in section G. In certain preferred embodiments, the immunogenic composition will comprise one or more adjuvants.

In another embodiment, the invention provides immunogenic compositions comprising a polynucleotide having a nucleotide sequence chosen from one of SEQ ID NO:1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591, wherein the polynucleotide is comprised in a recombinant expression vector. Preferably the vector is plasmid DNA. Of course, the polynucleotide may further comprise heterologous nucleotides, *e.g.*, the polynucleotide is operatively linked to one or more gene expression regulatory elements, and further comprise one or more adjuvants. In a preferred embodiment, the immunogenic polynucleotide composition directs the expression of a neutralizing epitope of *Streptococcus pneumoniae.*

Provided also are methods for immunizing a host against *Streptococcus pneumoniae* infection. In a preferred embodiment, the host is human. Thus, a host

or subject is administered an immunizing amount of an immunogenic composition comprising a polypeptide having an amino acid sequence chosen from one of SEQ ID NO:216 through SEQ ID NO:430 or SEQ ID NO: 592 through 752, a biological equivalent thereof or a fragment thereof and a pharmaceutically acceptable carrier. An immunizing amount of an immunogenic composition can be determined by doing a dose response study in which subjects are immunized with gradually increasing amounts of the immunogenic composition and the immune response analyzed to determine the optimal dosage. Starting points for the study can be inferred from immunization data in animal models. The dosage amount can vary depending upon specific conditions of the individual. The amount can be determined in routine trials by means known to those skilled in the art.

An immunologically effective amount of the immunogenic composition in an appropriate number of doses is administered to the subject to elicit an immune response. Immunologically effective amount, as used herein, means the administration of that amount to a mammalian host (preferably human), either in a single dose or as part of a series of doses, sufficient to at least cause the immune system of the individual treated to generate a response that reduces the clinical impact of the bacterial infection. Protection may be conferred by a single dose of the immunogenic composition or vaccine, or may require the administration of several doses, in addition to booster doses at later times to maintain protection. This may range from a minimal decrease in bacterial burden to prevention of the infection. Ideally, the treated individual will not exhibit the more serious clinical manifestations of the *Streptococcus pneumoniae* infection. The dosage amount can vary depending upon specific conditions of the individual, such as age and weight. This amount can be determined in routine trials by means known to those skilled in the art.

I. DIAGNOSTIC ASSAYS

The invention provides methods for detecting the presence of a *Streptococcus pneumoniae* polypeptide or *Streptococcus pneumoniae* polynucleotide, or fragment thereof, in a biological sample. The method involves contacting the biological sample with a compound or an agent capable of detecting a *Streptococcus pneumoniae* polypeptide or mRNA such that the presence of the *Streptococcus pneumoniae* polypeptide/encoding nucleic acid molecule is detected

in the biological sample. A preferred agent for detecting *Streptococcus pneumoniae* mRNA or DNA is a labeled or labelable oligonucleotide probe capable of hybridizing to *Streptococcus pneumoniae* mRNA or DNA. The nucleic acid probe can be, for example, a full-length *Streptococcus pneumoniae* polynucleotide of one of SEQ ID NO: 1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591, a complement thereof, or a fragment thereof, such as an oligonucleotide of at least 15, 30, 50, 100, 250 or 500 nucleotides in length and sufficient to specifically hybridize under stringent conditions to *Streptococcus pneumoniae* mRNA or DNA. Alternatively, the sample can be contacted with an oligonucleotide primer of a *Streptococcus pneumoniae* polynucleotide of one of SEQ ID NO: 1 through SEQ ID NO:215 or SEQ ID NO: 431 through SEQ ID NO: 591, a complement thereof, or a fragment thereof, in the presence of nucleotides and a polymerase, under conditions permitting primer extension.

A preferred agent for detecting *Streptococcus pneumoniae* polypeptide is a labeled or labelable antibody capable of binding to a *Streptococcus pneumoniae* polypeptide. Antibodies can be polyclonal, or more preferably, monoclonal. An intact antibody, or a fragment thereof (*e.g.*, Fab or F(ab')2) can be used. The term "labeled or labelable," with regard to the probe or antibody, is intended to encompass direct labeling of the probe or antibody by coupling (*i.e.*, physically linking) a detectable substance to the probe or antibody, as well as indirect labeling of the probe or antibody by reactivity with another reagent that is directly labeled. Examples of indirect labeling include detection of a primary antibody using a fluorescently labeled secondary antibody and end-labeling of a DNA probe with biotin such that it can be detected with fluorescently labeled streptavidin. The term "biological sample" is intended to include tissues, cells and biological fluids isolated from a subject, as well as tissues, cells and fluids present within a subject. That is, the detection method of the invention can be used to detect *Streptococcus pneumoniae* mRNA, DNA, or protein in a biological sample *in vitro* as well as *in vivo*. For example, *in vitro* techniques for detection of *Streptococcus pneumoniae* mRNA include Northern hybridizations and *in situ* hybridizations. *In vitro* techniques for detection of *Streptococcus pneumoniae* polypeptide include enzyme linked immunosorbent assays (ELISAs), Western blots, immunoprecipitations and immunofluorescence. Alternatively, *Streptococcus pneumoniae* polypeptides can be detected *in vivo* in a

subject by introducing into the subject a labeled anti-*Streptococcus pneumoniae* antibody. For example, the antibody can be labeled with a radioactive marker whose presence and location in a subject can be detected by standard imaging techniques.

The polynucleotides according to the invention may also be used in analytical DNA chips, which allow sequencing, the study of mutations and of the expression of genes, and which are currently of interest given their very small size and their high capacity in terms of number of analyses.

The principle of the operation of these chips is based on molecular probes, most often oligonucleotides, which are attached onto a miniaturized surface, generally of the order of a few square centimeters. During an analysis, a sample containing fragments of a target nucleic acid to be analysed, for example DNA or RNA labelled, for example, after amplification, is deposited onto the DNA chip in which the support has been coated beforehand with probes. Bringing the labelled target sequences into contact with the probes leads to the formation, through hybridization, of a duplex according to the rule of pairing defined by J.D. Watson and F. Crick. After a washing step, analysis of the surface of the chip allows the effective hybridizations to be located by means of the signals emitted by the labels tagging the target. A hybridization fingerprint results from this analysis which, by appropriate computer processing, will make it possible to determine information such as the presence of specific fragments in the sample, the determination of sequences and the presence of mutations.

The chip consists of a multitude of molecular probes, precisely organized or arrayed on a solid support whose surface is miniaturized. It is at the centre of a system where other elements (imaging system, microcomputer) allow the acquisition and interpretation of a hybridization fingerprint.

The hybridization supports are provided in the form of flat or porous surfaces (pierced with wells) composed of various materials. The choice of a support is determined by its physicochemical properties, or more precisely, by the relationship between the latter and the conditions under which the support will be placed during the synthesis or the attachment of the probes or during the use of the chip. It is therefore necessary, before considering the use of a particular support, to consider characteristics such as its stability to pH, its physical strength, its reactivity and its chemical stability as well as its capacity to nonspecifically bind nucleic acids.

Materials such as glass, silicon and polymers are commonly used. Their surface is, in a first step, called "functionalization", made reactive towards the groups which it is desired to attach thereon. After the functionalization, so-called spacer molecules are grafted onto the activated surface. Used as intermediates between the surface and the probe, these molecules of variable size render unimportant the surface properties of the supports, which often prove to be problematic for the synthesis or the attachment of the probes and for the hybridization.

Among the hybridization supports, there may be mentioned glass which is used, for example, in the method of *in situ* synthesis of oligonucleotides by photochemical addressing developed by the company Affymetrix (E.L. Sheldon, 1993), the glass surface being activated by silane. Genosensor Consortium (P. Mérel, 1994) also uses glass slides carrying wells 3 mm apart, this support being activated with epoxysilane.

The probes according to the invention may be synthesized directly *in situ* on the supports of the DNA chips. This *in situ* synthesis may be carried out by photochemical addressing (developed by the company Affymax (Amsterdam, Holland) and exploited industrially by its subsidiary Affymetrix (United States), or based on the VLSIPS (very large scale immobilized polymer synthesis) technology (S.P.A. Fodor *et al.*, 1991), which is based on a method of photochemically directed combinatory synthesis. The principle of which combines solid-phase chemistry, the use of photolabile protecting groups and photolithography.

The probes according to the invention may be attached to the DNA chips in various ways such as electrochemical addressing, automated addressing or the use of probe printers (T. Livache *et al.*, 1994; G. Yershov *et al.*, 1996; J. Derisi *et al.*, 1996, and S. Borman, 1996).

The revealing of the hybridization between the probes of the invention, deposited or synthesized *in situ* on the supports of the DNA chips, and the sample to be analysed, may be determined, for example, by measurement of fluorescent signals, by radioactive counting or by electronic detection.

The use of fluorescent molecules such as fluorescein constitutes the most common method of labelling the samples. It allows direct or indirect revealing of the hybridization and allows the use of various fluorochromes.

Affymetrix currently provides an apparatus or a scanner designed to read its

Gene Chip™ chips. It makes it possible to detect the hybridizations by scanning the surface of the chip in confocal microscopy (R.J. Lipshutz *et al.*, 1995).

The nucleotide sequences according to the invention may also be used in DNA chips to carry out the analysis of the expression of the *Streptococcus pneumoniae* genes. This analysis of the expression of *Streptococcus pneumoniae* genes is based on the use of chips where probes of the invention, chosen for their specificity to characterize a given gene, are present (D.J. Lockhart *et al.*, 1996; D.D. Shoemaker *et al.*, 1996). For the methods of analysis of gene expression using the DNA chips, reference may, for example, be made to the methods described by D.J. Lockhart *et al.* (1996) and Sosnowsky *et al.* (1997) for the synthesis of probes *in situ* or for the addressing and the attachment of previously synthesized probes. The target sequences to be analysed are labelled and in general fragmented into sequences of about 50 to 100 nucleotides before being hybridized onto the chip. After washing as described, for example, by D.J. Lockhart *et al.* (1996) and application of different electric fields (Sosnowsky *et al.*, 1997), the labelled compounds are detected and quantified, the hybridizations being carried out at least in duplicate. Comparative analyses of the signal intensities obtained with respect to the same probe for different samples and/or for different probes with the same sample, determine the differential expression of RNA or copy numbers of DNA derived from the sample.

The nucleotide sequences according to the invention may, in addition, be used in DNA chips where other nucleotide probes specific for other microorganisms are also present, and may allow the carrying out of a serial test allowing rapid identification of the presence of a microorganism in a sample.

Accordingly, the subject of the invention is also the nucleotide sequences according to the invention, characterized in that they are immobilized on a support of a DNA chip.

The DNA chips, characterized in that they contain at least one nucleotide sequence according to the invention, immobilized on the support of the said chip, also form part of the invention.

The chips will preferably contain several probes or nucleotide sequences of the invention of different length and/or corresponding to different genes so as to identify, with greater certainty, the specificity of the target sequences or the desired

mutation in the sample to be analysed.

Accordingly, the analyses carried out by means of primers and/or probes according to the invention, immobilized on supports such as DNA chips, will make it possible, for example, to identify, in samples, mutations linked to variations such as intraspecies variations. These variations may be correlated or associated with pathologies specific to the variant identified and will make it possible to select the appropriate treatment.

The invention thus comprises a DNA chip according to the invention, characterized in that it contains, in addition, at least one nucleotide sequence of a microorganism different from *Streptococcus pneumoniae,* immobilized on the support of the said chip; preferably, the different microorganism will be chosen from an associated microorganism, a bacterium of the *Streptococcus* family, and a variant of the species *Streptococcus pneumoniae*.

The principle of the DNA chip as explained above, may also be used to produce protein "chips" on which the support has been coated with a polypeptide or an antibody according to the invention, or arrays thereof, in place of the DNA. These protein "chips" make it possible, for example, to analyse the biomolecular interactions (BIA) induced by the affinity capture of target analytes onto a support coated, for example, with proteins, by surface plasma resonance (SPR). Reference may be made, for example, to the techniques for coupling proteins onto a solid support which are described in International Application EP 524 800 or to the methods describing the use of biosensor-type protein chips such as the BIAcore-type technique (Pharmacia) (Arlinghaus *et al.*, 1997, Krone *et al.*, 1997, Chatelier *et al.*, 1995). These polypeptides or antibodies according to the invention, capable of specifically binding antibodies or polypeptides derived from the sample to be analysed, may thus be used in protein chips for the detection and/or the identification of proteins in samples. The said protein chips may in particular be used for infectious diagnosis and may preferably contain, per chip, several polypeptides and/or antibodies of the invention of different specificity, and/or polypeptides and/or antibodies capable of recognizing microorganisms different from *Streptococcus pneumoniae*.

Accordingly, the subject of the present invention is also the polypeptides and the antibodies according to the invention, characterized in that they are immobilized on a support, in particular of a protein chip.

The protein chips, characterized in that they contain at least one polypeptide or one antibody according to the invention immobilized on the support of the said chip, also form part of the invention.

The invention comprises, in addition, a protein chip according to the invention, characterized in that it contains, in addition, at least one polypeptide of a microorganism different from *Streptococcus pneumoniae* or at least one antibody directed against a compound of a microorganism different from *Streptococcus pneumoniae,* immobilized on the support of the chip.

The invention also relates to a kit or set for the detection and/or the identification of bacteria belonging to the species *Streptococcus pneumoniae* or to an associated microorganism, or for the detection and/or the identification of a microorganism characterized in that it comprises a protein chip according to the invention.

The present invention also provides a method for the detection and/or the identification of bacteria belonging to the species *Streptococcus pneumoniae* or to an associated microorganism in a biological sample, characterized in that it uses a nucleotide sequence according to the invention.

The invention also encompasses kits for detecting the presence of a *Streptococcus pneumoniae* polypeptide in a biological sample. For example, the kit comprises reagents such as a labeled or labelable compound or agent capable of detecting *Streptococcus pneumoniae* polypeptide or mRNA in a biological sample; means for determining the amount of *Streptococcus pneumoniae* polypeptide in the sample; and means for comparing the amount of *Streptococcus pneumoniae* polypeptide in the sample with a standard. The compound or agent is packaged in a suitable container. The kit further comprises instructions for using the kit to detect *Streptococcus pneumoniae* mRNA or protein.

In certain embodiments, detection involves the use of a probe/primer in a polymerase chain reaction (PCR) (*see, e.g.* U.S. Patent 4,683,195 and U.S. Patent 4,683,202), such as anchor PCR or RACE PCR, or, alternatively, in a ligation chain reaction (LCR). This method includes the steps of collecting a sample of cells from a patient, isolating nucleic acid (*e.g.*, genomic, mRNA or both) from the cells of the sample, contacting the nucleic acid sample with one or more primers which specifically hybridize to a *Streptococcus pneumoniae* polynucleotide under conditions

such that hybridization and amplification of the *Streptococcus pneumoniae*-polynucleotide (if present) occurs, and detecting the presence or absence of an amplification product, or detecting the size of the amplification product and comparing the length to a control sample.

All patents and publications cited herein are hereby incorporated by reference.

EXAMPLES

The following examples are carried out using standard techniques, which are well known and routine to those of skill in the art, except where otherwise described in detail. The following examples are presented for illustrative purpose, and should not be construed in any way limiting the scope of this invention.

EXAMPLE 1

BIOINFORMATICS AND GENE MINING OF *STREPTOCOCCUS PNEUMONIAE*

The genomic sequence of *Streptococcus pneumoniae* was downloaded from The Institute for Genomic Research (TIGR) website and novel open reading frames (ORFs) were determined in the following manner. An ORF was defined as having one of three potential start site codons, ATG, GTG or TTG and one of three potential stop codons, TAA, TAG or TGA. The inventors used a unique set of two ORF finder algorithms: GLIMMER (Salzberg *et al.*, 1998) and inventors' assignee's program to enhance the efficiency for finding "all" ORFs. In order to evaluate the accuracy of the ORFs determined, a program developed by inventors' assignee called DiCTion was employed that uses a discrete mathematical cosine function to assign a score for each ORF. An ORF with a DiCTion score > 1.5 is considered to have a high probability of encoding a protein product. The minimum length of an ORF predicted by the two ORF finding algorithms was set to 225 nucleotides (including stop codon) which would encode a protein of 74 amino acids. As a final search for remnants of ORFs, all noncoding regions > 75 nucleotides were searched against the public protein databases (described below) using tBLASTn. This helped to identify regions of genes that contain frameshifts (Mejlhede *et al.*, 1999) or fragments of genes that might have a role in causing antigenic variation (Fraser *et al.*, 1997). A graphical analysis program developed by inventors' assignee also allowed the inventors to see

all six reading frames and the location of the predicted ORFs relative to the genomic sequence for further inspection. This helped to eliminate those ORFs that have large overlaps with other ORFs, although there are known cases of ORFs being totally embedded within other ORFs (Loessner *et al.,* 1999; Hernandez-Sanchez *et al.*, 1998).

The initial annotation of the *Streptococcus pneumoniae* ORFs was performed using the BLAST (v. 2.0) Gapped search algorithm, Blastp, to identify homologous sequences (Altschul *et al.*, 1997). A cutoff 'e' value of anything < e^{-10} was considered significant. Other search algorithms such as FASTA or PSI-BLAST were used as needed. The non-redundant protein sequence database used for the homology searches consisted of GenBank, SWISS-PROT (Bairoch and Apweiler, 2000), PIR (Barker *et al.*, 2001), and TREMBL (Bairoch and Apweiler, 2000) database sequences updated daily. ORFs with a Blastp result of > e^{-10} were considered to be unique to *Streptococcus pneumoniae*.

A keyword search of the entire BLAST results was carried out using known or suspected target genes for immunogenic compositions, as well as words that identified the location of a protein or function.

Several parameters were used to determine grouping of the predicted proteins. Proteins destined for translocation across the cytoplasmic membrane encode a leader signal (also called signal sequence) composed of a central hydrophobic region flanked at the N-terminus by positively charged residues (Pugsley, 1993). A program, called SignalP, identifies signal peptides and their cleavage sites (Nielsen *et al.*, 1997). To predict protein localization in bacteria, the software PSORT has been used (Nakai and Kanehisa, 1991). This program uses a neural net algorithm to predict localization of proteins to the 'cytoplasm', 'periplasm', and 'cytoplasmic membrane' for Gram-positive bacteria as well as 'outer membrane' for Gram-negative bacteria. Transmembrane (TM) domains of proteins have been analyzed using the software program TopPred II (Cserzo *et al.*, 1997).

The Hidden Markov Model (HMM) Pfam database of multiple alignments of protein domains or conserved protein regions (Sonnhammer *et al.*, 1997) was used to identify *Streptococcus pneumoniae* proteins that may belong to an existing protein family. Keyword searching of this output was used to help identify additional candidate ORFs that may have been missed by the BLAST search criteria. A

computer algorithm, called HMM Lipo, was developed by inventors' assignee to predict lipoproteins using approximately 131 biologically proven bacterial lipoproteins. This training set was generated from experimentally proven prokaryotic lipoproteins. The protein sequence from the start of the protein to the cysteine amino acid plus the next two additional amino acids was used to generate the HMM. Using approximately 70 known prokaryotic proteins containing the LPXTG cell wall sorting signal, a HMM (Eddy, 1996) was developed to predict cell wall proteins that are anchored to the peptidoglycan layer (Mazmanian *et al.*, 1999; Navarre and Schneewind, 1999). The model used not only the LPXTG sequence but also included two features of the downstream sequence, first the hydrophobic transmembrane domain and secondly, the positively charged carboxy terminus. There are also a number of proteins that interact, non-covalently, with the peptidoglycan layer and are distinct from the LPXTG protein class described above. These proteins seem to have a consensus sequence at their carboxy terminus (Koebnik, 1995). The inventors' assignee has also developed and used a HMM of this region to identify any *Streptococcus pneumoniae* that may fall into this class of proteins.

The proteins encoded by *Streptococcus pneumoniae* identified ORFs were also evaluated for other useful characteristics. A tandem repeat finder (Benson, 1999) identified ORFs containing repeated DNA sequences such as those found in MSCRAMMs (Foster and Hook, 1998) and phase variable surface proteins of *Neisseria meningitidis* (Parkhill *et al.*, 2000). Proteins that contain the Arg-Gly-Asp (RGD) attachment motif, together with integrins that serve as their receptor, constitute a major recognition system for cell adhesion. RGD recognition is one mechanism used by microbes to gain entry into eukaryotic tissues (Stockbauer *et al.*, 1999; Isberg and Tran Van Nhieu, 1994). However, not all RGD containing proteins mediate cell attachment. It has been shown that RGD containing peptides with a proline at the carboxy end (RGDP) are inactive in cell attachment assays (Pierschbacher and Ruoslahti, 1987) and are excluded. The Geanfammer software was used to cluster proteins into homologous families (Park and Teichmann, 1998). Preliminary analysis of the family classes has provided novel ORFs within a candidate cluster as well as defining potential protein function.

EXAMPLE 2
CLONING, EXPRESSION AND ANALYSIS OF PREDICTED ORF PROTEINS

MATERIALS AND METHODS

Growth of *Streptococcus pneumoniae*. *Streptococcus pneumoniae* were grown in Todd Hewitt broth (Difco) supplemented with 0.5% yeast extract. Bacteria were incubated at 35°C in 5% CO_2 without shaking. Mid-log phase cultures (OD_{550} approx 0.3) were harvested after approximately 4 hours incubation and cells pelleted by centrifugation (5,000 x g) at 4°C.

Cloning and expression of predicted ORFs. The predicted ORFs were cloned and expressed in *E. coli* Top10 or BLR(DE3). Expression of each ORF was tested in both pBAD/Thio-TOPO (which contains an arabinose inducible promoter) and pCR-T7/NT-TOPO expression systems (Invitrogen, Carlsbad, CA). Gene specific primers were designed to amplify, by polymerase chains reaction (PCR), each selected ORF from *Streptococcus pneumoniae* CP1200 (Morrison *et al.*, 1983) genomic DNA purified using the Wizard Genomic DNA purification kit (Promega, Madison, WI). The 5′ primers were designed to exclude the predicted signal sequence (as predicted by SignalP) and the 3′ primer was designed to either include the stop codon (pCR-T7) or exclude the stop codon (pBAD). ORFs were amplified in a standard polymerase chain reaction (200 μM each dNTP (Invitrogen), 200 μM each 5′ and 3′ gene specific primer, 1 μL stock of chromosomal DNA, 2.5U *Pfu* Turbo polymerase (Stratagene, LaJolla, CA) and 1x *Pfu* Turbo reaction buffer in a total volume of 50 μL). Overhanging A's were added to the PCR products by incubation for 10 minutes at 72°C with 1U of Taq DNA polymerase (Roche Diagnostics, Indianapolis, IN). PCR products were cloned into the expression vectors and transformed into *E. coli* TOP10 following manufacturer's TOPO-TA cloning protocol (Invitrogen). Positive clones were identified by PCR using one gene specific primer and one vector specific primer to ensure correct orientation.

ORFs cloned into pCR-T7 were transformed into *E. coli* BL21(DE3) for protein expression using the T7 promoter and those cloned into pBAD were kept in TOP10. Protein expression was determined by growing overnight cultures of the positive clones in 2 mL HySoy broth (DMV International Nutritional, Fraser, NY)

supplemented with 100 µg/mL ampicillin. These cultures were then diluted 1:100 into fresh media and grown until OD_{600} = 1.0. Protein expression was induced with either 2% arabinose (pBAD) or 0.1 mM IPTG (pCRT7). Three hours post-induction, the cells were harvested and protein expression determined by Western blot analysis of whole-cell lysates using either anti-express epitope (pCRT7) or anti-thio (pBAD) antibodies. The best expressing clone (pBAD or pCRT7) was used for protein production and purification.

Fourteen of the ORFs that did not express in either pCRT7 or pBAD were cloned into pET27b(+) (Novagen, Madison, WI). The ORFs were again amplified by PCR and cloned using standard molecular biology techniques into the NcoI and XhoI sites of pET27b(+). Clones were again screened by PCR, and plasmids with the correct insert were transformed into BL21(DE3) and expression tested as described for pCR-T7. Protein expression was determined by Western blot analysis using anti-HSV epitope antibody.

Purification of Soluble His-tag ORF Proteins. Protein was expressed from positive clones in 4 x 1L of media as described above. Cells were harvested by centrifugation, resuspended in 100 mL of Ni Buffer A (20mM Tris, pH 7.5, 150 mM NaCl) and lysed by 2 passages through a French pressure cell at 16,000 psi (SLM Instruments, Inc., Rochester, NY).

For soluble proteins, the cell debris was pelleted by centrifugation at ~9,000 x g and the supernatant was loaded onto an iminodiaceticacid sepharose 6B (Sigma Chemical, St. Louis, MO) column charged with Ni^{2+}. Unbound proteins were washed from the column with Ni buffer A until A_{280} of eluate reached a baseline. The bound protein was then eluted with Ni buffer A containing 300 mM imidazole (Sigma Chemical). Purity was estimated by SDS-PAGE.

Samples requiring further purification were concentrated and buffer exchanged over a PD-10 column (Amersham-Pharmacia Biotech, Piscataway, NJ) equilibrated with buffer A (20 mM Tris, pH 8.0). The eluate was loaded onto a Q-sepharose High Performance (Amersham-Pharmacia Biotech) column and eluted with a 0–35% Buffer B (20 mM Tris, pH 8.0, 1M NaCl) gradient. Protein-containing fractions were determined by SDS-PAGE. All protein purification was done using an AKTA Explorer (Amersham-Pharmacia Biotech).

Isolation and Solubilization of Insoluble His-tag fusion proteins. Bacterial cell pellets were suspended at a ratio of 5:1 (buffer volume:pellet wet weight) in 10 mM $NaPO_4$/150mM NaCl/pH 7.0 with Complete Protease Inhibitor Cocktail containing EDTA (Roche Diagnostics GmbH, Mannheim, Germany). The cells were disrupted using a Microfluidizer (Microfluidics Corp., Newton, MA) and centrifuged at 21,900 x g for 30 minutes at 4°C. The pellet, containing insoluble His-tag proteins, was subjected to a series of detergent extractions followed by a final solubilization step using 6M urea. The pellet was resuspended in 10 mM $NaPO_4$/150 mM NaCl/pH 7.0 containing Complete Protease Inhibitor Cocktail and 1.0% Triton X-100 (TX-100) using the same 5:1 ratio described above. The suspension was stirred at 4°C for 30 minutes and centrifuged at 21,900 x g for 20 minutes at 4°C. The supernatant was removed and stored at 4°C for further analysis. The pellet was subjected to a second TX-100 extraction, as described, and the supernatant removed and stored at 4°C for further analysis. The TX-100 pellet was then resuspended in 10 mM $NaPO_4$/150 mM NaCl /pH 7.0 containing Complete Protease Inhibitor Cocktail and 1.0% Zwittergent 3-14 (Z3-14) and stirred at 4°C for a minimum of 1 hour. The suspension was centrifuged at 21,900 x g for 20 minutes at 4°C. The supernatant was removed and stored at 4°C for further analysis. The Z3-14 pellet was resuspended in 100 mM Tris-HCl/6M urea/pH 8.0 and stirred a minimum of 4 hours at room temperature. The suspension was centrifuged at 21,900 x g for 20 minutes at 4°C and the supernatant stored at 4°C for further analysis.

Purification of Solubilized His-tag fusion proteins. Isolated extracts containing His-tag fusion proteins were identified as described by SDS-PAGE and/or Western blot analysis. Chromatography was carried out using POROS MC 20 micron metal chelate Ni^{2+} media (Perseptive Biosystems, Framingham, MA) prepared according to the manufacturer. Protein extracts were loaded at approximately 5-10 mg of total protein per mL of column media.

For preparations in which the His-tag proteins were soluble in either the cytosolic fraction or detergent extractions by TX-100 or Z3-14, the material was applied directly to a MC 20 column equilibrated with a minimum of 3 column volumes of 10mM $NaPO_4$/150 mM NaCl/pH 7.0 for cytosolic proteins, or the same buffer containing either 1.0% TX-100 or 1.0% Z3-14 for proteins isolated in the TX-100 and Z3-14 extractions respectively. For cytosolic material, unbound proteins were

washed through the column with a minimum of 5 column volumes of equilibration buffer. For TX-100 or Z3-14 containing extracts, unbound proteins were washed through the column with equilibration buffer containing either 0.05% TX-100 or Z3-14, depending on the solubility characteristics of the particular protein. His-tag fusion proteins were eluted using a step gradient of 2 column volumes each of 25 mM, 50 mM, 125 mM, and 250 mM imidazole in 10mM $NaPO_4$/150 mM NaCl/pH 7.0 containing either 0.05% TX-100 or 0.05% Z3-14. Fractions containing His-tag protein were identified by SDS-PAGE and pooled. Imidazole was removed by dialysis into an appropriate buffer. Protein concentration was determined by BCA assay (Pierce) and, if necessary, preparations were concentrated by either ultrafiltration using Centriprep YM-10 membranes (Millipore, Bedford, MA) or by applying the material to a smaller MC 20 column, under the conditions described, and eluting with 250 mM imidazole followed by dialysis. Protein purity was estimated by SDS-PAGE and scanning densitometry.

For preparations in which urea was used to denature and solubilize the protein, the material was diluted 3 fold with 100 mM Tris-HCl/0.05% TX-100/pH 7.5 to give a final urea concentration of 2 M. The material was applied to a MC 20 column equilibrated with a minimum of 3 column volumes of 100 mM Tris-HCl/0.05% TX-100/2 M urea/pH 7.5 and unbound proteins were washed through the column with a minimum of 5 column volumes of equilibration buffer. His-tag fusion proteins were eluted using a step gradient of 2 column volumes each of 25 mM, 50 mM, 125 mM, and 250 mM imidazole in 100 mM Tris-HCl/0.05% TX-100/2 M urea pH 7.5. Fractions containing His-tag protein were identified by SDS-PAGE and pooled. Imidazole and urea were removed, and the protein refolded by dialysis into an appropriate buffer containing 0.05% TX-100. If necessary, preparations were concentrated by either ultrafiltration using Centriprep YM-10 membranes (Millipore, Bedford, MA) or by applying the material to a smaller MC 20 column, under the conditions described, and eluting with 250 mM imidazole followed by dialysis. Protein purity was estimated by SDS-PAGE and scanning densitometry.

<u>SDS-PAGE & Western Analysis</u>. SDS-PAGE was carried out as described by Laemmli (Laemmli, 1970), using 10-20% (wt/vol) gradient acrylamide gels (Zaxis, Hudson, OH). Proteins were visualized by staining the gels with Simply Blue Safestain (Invitrogen Life Technologies,Carlsbad, CA). The gels were scanned with

a Personal Densitometer SI (Molecular Dynamics Inc., Sunnyvale, CA) and purities were estimated using the Image Quant software (Molecular Dynamics Inc.).

Transfer of proteins to polyvinylidene difluoride (PVDF) membranes was accomplished with a semidry electroblotter and electroblot buffers (Owl Separation Systems, Portsmouth, NH). The PVDF membrane, containing the transferred protein, was blocked with 5 % non-fat dry milk prepared in PBS (Blotto) for 30 minutes. The membrane was then probed with one of the following primary antibody preparations at the indicated dilution specific for the individual protein expression system: Invitrogen anti-Xpress (1:5000), Invitrogen anti-thioredoxin (1:2000), Novagen anti-HSV epitope (1:5000), Qiagen anti-4X His (1:5000). The membrane was then washed with Blotto followed by Goat anti-mouse alkaline phosphatase conjugate (1:1500) as the secondary antibody (Biosource International, Camarillo, CA). Western blots were developed with 5-bromo-4-chloro-indolylphosphate-nitroblue tetrazolium (BCIP/NBT) phosphatase substrate system (Kirkegaard and Perry Laboratories, Gaithersburg, MD).

Protein quantitation. Protein concentrations were estimated by the bicinchoninic assay (Pierce, Rockford, IL) with bovine serum albumin as the standard.

Production of anti-ORF sera in mice. Female Swiss Webster mice (Taconic Farms, Germantown, NY) with ages 6 to 8 weeks old were immunized subcutaneously in the neck at weeks 0, 4, and 6 weeks with purified His tag protein. Two separate immunogenic compositions were prepared with each His-tag protein. One immunogenic composition was prepared with the protein formulated with STIMULON™ QS-21 and a second was prepared with the protein formulated with MPL™. Each dose for one group of mice contained 10 µg of purified protein and 20 µg STIMULON™ QS-21, while each dose for the second group of mice contained 10 µg of the same protein and 50 µg MPL™. Serum samples were collected at weeks 0, 4, 6 and 8. Mice were housed in a specific-pathogen free facility and provided water and food ad-libitum.

Pneumococcal whole-cell ELISAs. *Streptococcus pneumoniae* strains, either type 3 or type 14, were grown in Todd Hewitt broth (Difco) containing 100 µg/ml streptomycin at 35°C without shaking. The bacteria were grown to mid-log phase (OD_{550} <1.0), and heat inactivated for 1 hour at 60°C. Bacteria were pelleted at

10,000 x g and resuspended in PBS to an OD_{550} = 0.1. Fifty-five µl of this suspension was then added to each well of 96-well Nunc plates and air dried at room temperature. Plates were stored at 4°C until used.

Wells were blocked with 150 µl/well of PBS containing 5% (wt/vol) dry milk (blocking buffer) for 1 hour. Wells were washed 5 times with PBS in a Skantron washer, and mouse sera diluted in blocking buffer (100 µl/well) added. Plates were incubated at room temperature for 2 hours and unbound antibodies removed by washing 5 times with PBS in a Skantron washer. Bound antibodies were detected with 100 µl/well of peroxidase-labeled goat anti-mouse IgG (1:1,000 dilution of 1mg/ml in PBS; KPL) at room temperature for 2 hours. Plates were washed with PBS as above, and developed with 100 µl/well ABTS (KPL) for 25 minutes at room temperature. The reactions were stopped with 100 µl/well of 1% SDS and the OD_{405} of each well read on a VERSAmax microplate reader (Molecular Devices Corp., Sunnyvale, Calif.). Endpoint titers of each test serum were calculated as the inverse of the highest mean dilution giving an OD_{405} = 0.1.

FACS analysis of *Streptococcus pneumoniae*. Strains type 3 and 19F were grown in Todd-Hewitt broth + 0.5% yeast extract from frozen stocks of OD_{600}~1.0 cells. Incubation was at 37°C for 3 to 4 hours without shaking. 2-3x10^7 cells, 100 µl of OD_{600}=0.5 for type3, and 50 µl for 19F, were pipetted into a 96-well microtiter plate and spun at 4000 rpm in an Eppendorf tabletop centrifuge for 5 minutes. Supernatant was aspirated and cells were resuspended in 95 µl PBS-0.5%BSA-0.1% gelatin. Five µl primary antibody was added, mixed and left incubating on ice for 1 hour. Cells were pelleted as before, washed twice with 100 µl buffer and resuspended in 99 µl buffer. One µl goat anti-mouse secondary antibody conjugated to Alexa Fluor 488 (Molecular Probes, Eugene, OR) was added to the samples, mixed and left incubating on ice for 30 minutes. Cells were washed as before and resuspended in 100 µl buffer. Before analyzing on the FACSVantageSE unit, samples were diluted to 1 ml with buffer. Samples were read on a Becton Dickinson FACSVantage unit with an Enterprise II laser. Excitation was at 488nm and emission was detected with a photomultiplier tube using a 530/30 filter. Week 0 antisera were run as background control for the week 8 antisera.

Comparison of message from cells grown *in vitro* and *in vivo*. Messenger RNA (mRNA) levels for specific transcripts can be examined by creating a double

stranded cDNA from the mRNA using reverse transcriptase. This cDNA is then amplified using standard PCR conditions. The resulting amplification products are thus indicative of the message produced. This technique is useful for comparing the expression of specific transcripts under varying environmental conditions, such as growth in culture flasks versus growth *in vivo.*

Preparation of RNA from cells grown *in vitro*. *In vitro* grown *Streptococcus pneumoniae* serotypes were grown to log phase in 60 ml THB –0.5%YE at 37°C with 5% CO_2. Bacterial cells were harvested by centrifugation at 1000 x g for 15 minutes at 4°C. The supernatant was aspirated and the cells were resuspended in 1ml RNAlater (Ambion, Austin, TX) and stored for >1 hour at 4°C. The cells were then centrifuged in a microfuge for 5 minutes at 8000 x g. The supernatant was aspirated and the cells were resuspended in 100 µl 10% deoxycholate (DOC). 1100 µl of RNAZOL B (Tel-Test, Inc) were then added and the suspension mixed briefly by inversion. 120 µl of $CHCl_3$ were then added, the sample mixed by inversion and then centrifuged in a microfuge at full speed for 10 minutes at 4°C . The aqueous layer was removed and the RNA was precipitated by addition of an equal volume of 2-propanol. The RNA was incubated at 4°C for >1 hour and then centrifuged in a microfuge at full speed for 10 minutes at room temperature. The supernatant was aspirated and the RNA was washed with 75% ETOH and recentrifuged for 5 minutes. The supernatant was aspirated and the RNA was resuspended in 50-100 µl nuclease- free water. DNA was removed from the RNA by treating the sample with RNAse-free DNAase (DNA FREE, Ambion) for 20 minutes at 37 °C, followed by inactivation of the enzyme by addition of the DNA FREE chelator. The purity and yield of the RNA was assessed by measuring the absorbance at 260 nm and 280 nm. Absorbance ratios were typically 1.9-2.0. RNA was stored at –70°C.

Preparation of RNA from cells grown *in vivo*. *In vivo* grown *Streptococcus pneumoniae* serotypes were harvested from sealed dialysis tubing incubated in the peritoneal cavities of Sprague-Dawley rats as described by Orihuela *et al.* (2000). Log phase *Streptococcus pneumoniae* cells were prepared as described above and resuspended to 10^6 cfu/ml in RPMI media (Celltech) supplemented with 0.4% glucose. One ml of the cell suspension was sealed in a PVDF dialysis membrane with a 80,000 M_W cutoff (SprectraPor). Two such bags were implanted intraperitoneally in 400g Sprague Dawley rats (Taconic). The bags remained in the

rats for 22 hours, after which the rats were terminated and the bags were harvested. RNA was prepared from the intraperitoneally grown cells as described above.

RT-PCR to examine message levels. Specific message for each candidate gene was amplified out from RNA prepared from both *in vitro* and *in vivo* grown cells using RT-PCR. For each reaction, 0.5 µg RNA was incubated with 0.25 µM of the reverse mining primer for 3 minutes at 75°C, then cooled on ice and transferred to 44°C. The message was reverse transcribed using the RETROscript (Ambion) kit according to the manufacturer's directions. ReddyMix (ABgene) was used according to the manufacturer's directions to amplify each message from 2-5 µl of the sample, using 0.25 µM of the above reverse primer and the forward mining primer. Following amplification, 10 µl of the amplified product was electrophoresed on a 1% agarose gel.

RESULTS

Cloning of ORFs into expression vectors. Fifty-nine ORFs were selected for cloning and expression based on prediction of surface exposure from genomic analysis as described above. These ORFs were amplified by PCR and cloned into the expression vectors as described in Materials and Methods. The ORFs were cloned into pBAD/Thio-TOPO and pCR-T7/NT-TOPO. Both vectors fuse a hexahistidine tag and a unique epitope to facilitate purification and identification by western blot respectively. The pBAD vector also fuses a thioredoxin moiety to the cloned protein to enhance solubility.

Expression of ORFs in *E. coli*. The genes encoding all 59 ORFs were induced in the appropriate host *E. coli* strains and examined for expression by SDS-PAGE and western blot analysis of whole cell extracts. Of the 59 ORFs, a total of 24 (41%) were expressed at detectable levels. Fourteen of the ORFs that did not express in either of the expression vectors were cloned into pET27b(+) which fuses a hexahistidine tag to the C-terminus and a PelB leader sequence at the N-terminus of the protein. One of the 14 ORFs cloned into pET27b(+) expressed protein.

Purification of Expressed ORF Proteins. All of the expressed ORFs contained a 6X His motif to aid in purification. Initial purification of all of the proteins was done using a Ni containing resin according to manufacturer's directions. Twenty of the expressed ORF proteins were purified to acceptable levels of homogeneity for

immunization studies using this affinity purification (Table 17). Specific purification conditions used are detailed in Materials and Methods and in Table 17. Thirteen of the 20 ORF proteins were used to immunize mice and obtain antisera specific for the expressed protein.

Table 17

Purification of Expressed *S. pneumoniae* ORF Proteins

ORF #	[Protein] mg/ml	Total Protein mg	Purity %	Final Buffer	"PSORT" PREDICTED Location	Location in *E. coli*
75	0.52	6.8	94%	PBS/1mM EDTA pH 7.4	Outer membrane	Cytosol
2615	0.42	16.8	80%	PBS/1mM EDTA pH 7.4	Outer membrane	Cytosol
3039	0.53 (0.14)	2.91	82%	0.1MTris/150mM NaCl/ 0.05%Zw3-14/1mM EDTA pH 8.0	Outer membrane	Inclusion Bodies
1143	1.4	196	92%	PBS/0.05%tx-100/ 1mM EDTA pH 7.4	Inner membrane	Inclusion Bodies
1835	0.5 (0.2)	10.5	91.3%	PBS/0.05%tx-100/ 1mM EDTA pH 7.4	Inner membrane	Inclusion Bodies
1568	1.0	5.0	>85%	PBS/0.05%tx-100/ 1mM EDTA pH 7.4	Inner membrane	Inclusion Bodies
2271	4.9	122.5	>90%	PBS, pH 7.4	Inner Membrane	Cytosol
2621	1.5	4.5	>90%	PBS, pH 7.4	Inner Membrane	Cytosol
1104	2.0	-	85-90%	PBS, pH 7.4	Outer Membrane	Cytosol
935	0.1	.5	85%	50mM Glycine-NaOH/ 150mM NaCl/ 0.05%Z3-14 pH 10.0	Outer membrane	Inclusion Bodies

3361	1.67	3.34	98%	PBS/1mM EDTA pH 7.4	Inner membrane	Cytosol
339	0.91 (0.91)	127.4 (27.3)	93.2% (80.8%)	PBS/0.05%tx-100/ 1mM EDTA pH 7.4	Inner Membrane	Inclusion Bodies
2322	0.55 (0.23)	2.5 (0.92)	90%	BS/0.05%tx-100/ 1mM EDTA pH 7.4	Inner Membrane	Inclusion Bodies
1476	1.2 (0.6)	9.6	>80%	PBS/0.05%tx-100/ 1mM EDTA pH 7.4	Inner Membrane	Inclusion Bodies
3115	0.2 (0.5)	2.8	>85%	PBS/0.05%tx-100/ 1mM EDTA pH 7.4	Inner Membrane	Inclusion Bodies
132	4.6	460	95%	PBS pH 7.4	-	Cytosol
3386	3.1	27	85%	PBS pH 7.4	Inner Membrane	Cytosol
2112	0.6	1.8	85%	PBS pH 7.4	Inner Membrane	Cytosol
916	0.26	1.3	>85%	PBS 0.05% Tx-100 pH 7.4	-	Inclusion Bodies
3373	0.97	1.9	84%	PBS 0.05% Z3-14 pH 7.4	Inner Membrane	Inclusion Bodies

Expression of ORF proteins in *Streptococcus pneumoniae* whole cell lysates. To determine if the ORFs are being expressed in *Streptococcus pneumoniae*, whole cell lysates of *in vitro* grown cells were probed with the antisera in Western blot analysis. Each antiserum was reactive with the purified recombinant protein as a positive control (data not shown). Whole cell lysates from *Streptococcus pneumoniae* strains type 3, type 14, and type 19F were examined in Western blot, and the results are summarized in Table 18. Proteins from three of the ORFs were undetectable or barely detectable in all of the strains tested. Proteins from eight of the ORFs were expressed in at least 2 of the strains, while proteins from two ORFs were detected in only one of the three strains examined. These results demonstrate that the majority of the proteins from these ORFs were expressed in late log, early stationary phase *Streptococcus pneumoniae*, and that some strains may not express detectable amounts of each ORF at the time point examined.

Table 18

Whole Cell ELISA and Western Blot Expression Data for *S. pneumoniae* ORFs

		Whole Cell ELISA		Western Blot Expression *In vitro*			FACS Analysis	
Vaccine (10 μg)	Adjuvant (20 μg)	Type 3	Type 14	Type 3	Type 14	Type 19F	Type 3	Type 19F
2615	QS21	<200	<200	-	-	-	-	-
3039	QS21	<200	<200	+	++	++	-	-
75	QS21	256	<200	+++	+++	+++	+	-
1568	QS21	4,018	<200	++	+++	+++	-	-
1143	QS21	779	<200	+	++	+	+	-
1835	QS21	202	<200	-	+/-	-	+	-
2271	QS21	442	<200	+++	+++	+++	+	-
2621	QS21	739	<200	++	+	-	++	-
1104	QS21	409	<200	+++	+++	+++	+	-
339	QS21	<200	<200	-	+/-	-	-	ND
2322	QS21	<200	<200	-	-	+/-	-	ND
3361	QS21	<200	<200	-	+	+	+	ND
935	QS21	<200	<200	-	-	-	-	ND
Standard		~45,000	~10,000	ND	ND	ND		

Surface exposure of ORF proteins: Whole Cell ELISA. The 13 antisera against the recombinant ORF proteins were tested for surface reactivity by whole cell ELISA against two strains of *Streptococcus pneumoniae*, type 3 and type 14. The results are shown in Table 18. Seven of the 13 antisera gave detectable whole cell titers against type 3 *Streptococcus pneumoniae*, while none of them gave detectable titers against the type 14 strain. When anticapsular serum was tested against the homologous capsular serotype, the titer against the type 14 strain was much lower than that against the type 3 strain (*see* row labeled "standard" in Table 18). This result indicated that there might have been sensitivity issues with the type 14 whole cell ELISA, because the Western blot data clearly demonstrate that type 14 *Streptococcus pneumoniae* do express the majority of the proteins of the ORFs (Table 18). The whole cell ELISA titers of antiserum against the proteins of ORF 75 (SEQ ID NO:218), ORF 1104 (SEQ ID NO:282), ORF 2621 (SEQ ID NO:363), ORF 1568 (SEQ ID NO:306), ORF 1143 (SEQ ID NO:285), ORF 2271 (SEQ ID NO:343), and ORF 1835 (SEQ ID NO:315) ranged from slightly above background to 20 times

above background. These results indicate that these antisera detect at least some surface exposed epitopes for these ORFs.

Surface exposure of ORF proteins: FACS Analysis. The polyclonal antisera against the proteins from ORFs 2615, 3039, 75, 1568, 1143, 1835, 2271, 2621, 1104, 339, 2322, 3361 and 935, were analyzed for surface reactivity with whole *Streptococcus pneumoniae* cells by FACS analysis as described above. The results of the analyses are shown in Table 18. *Streptococcus pneumoniae* type 3 cells showed a 9-fold increase in geometric mean fluorescence intensity when labeled with antiserum to ORF 2621 (SEQ ID NO:363). A less intense fluorescence intensity was detected with antisera directed against the proteins of ORF 1835 (SEQ ID NO:315), ORF 2271 (SEQ ID NO:343), ORF 75 (SEQ ID NO:218), ORF 1143 (SEQ ID NO:285), and ORF 1104 (SEQ ID NO:282). Nine of the antisera tested did not show any detectable surface reactivity with the *Streptococcus pneumoniae* type 19F strain. This may be due to the level of sensitivity of the technique or the capsule of 19F covering the surface exposed proteins more completely under the conditions tested.

Analysis of ORF mRNA expression *in vitro* vs. *in vivo*. Forward and reverse mining primers were used to amplify the full length message for several ORFs, identified by mining algorithms as potential vaccine antigens (Example 1), from type 3 and type 14 cells grown under *in vitro* and *in vivo* conditions. In three of the four ORFs examined, message was detected in both *in vitro* and *in vivo* grown cells. For ORFs 1104 (SEQ ID NO:282) and 1568 (SEQ ID NO:306), the detection of message correlated with the presence of an immunoreactive band on a Western blot of whole cell lysates for the same serotypes. However for ORF 2322 (SEQ ID NO:345), message was detected in both serotype 3 and 14, but no immunoreactive band was present for those serotypes, indicating that either the protein was secreted or that the antibodies generated by the recombinant protein did not recognize the native protein. No message was detected for ORF 935 (SEQ ID NO:265) in either growth condition, which correlates with the absence of an immunoreactive band on a Western blot. In a separate experiment, message of the expected size was detected from RNA made from serotype 14 grown *in vitro* for ORFs 1143 (SEQ ID NO:285), 1475 (SEQ ID NO:298), 3039 (SEQ ID NO:380), 2271 (SEQ ID NO:343), 3115 (SEQ ID NO:388) and 3361 (SEQ ID NO:402)(data not shown).

DISCUSSION

Prediction of surface exposure is a critical step for genomic mining efforts for identifying candidate antigens. The algorithms utilized herein have been shown in the past to have predictive value for selecting candidate ORFs to examine. The results shown here demonstrate the utility of the algorithms for *Streptococcus pneumoniae* and that they represent an advance over the previously utilized algorithms. Here, 7 out of 13 proteins from ORFs tested are shown to be surface exposed by at least two of the techniques employed. These techniques, including whole cell ELISA and FACS analysis of whole *Streptococcus pneumoniae* cells, have different strengths for detection of surface exposed epitopes of proteins. Whole cell ELISA utilizes fixed cells bound to a solid phase support, while FACS analysis uses living *Streptococcus pneumoniae* in liquid suspension. However, the whole cell ELISA is more sensitive than the FACS analysis, and can thus give a more quantitative determination of surface exposed epitopes at low levels of antibody binding. It is not known why the protein of ORF 2621 was so strongly positive in the FACS analysis, yet had a comparatively low whole cell ELISA titer (Table 18). This may be the result of differing growth conditions or the differing detection conditions employed in each of the assays. However, the data are consistent in that the proteins from 6 ORFs that are noted to have surface exposed epitopes all are positive in both assays employed.

The lack of detection of surface exposure in the 19F strain by FACS is puzzling. None of the ORFs had detectable epitopes on the surface of the 19F strain in the FACS technique used, but the majority of them were well expressed in whole cell lysates from this strain (Table 18). This may be due to the unique capsular material of 19F covering the surface exposed proteins, or that the FACS technique is less sensitive against type 19F cells. It is also possible that none of the proteins tested have surface exposed epitopes in type 19F, but this is extremely unlikely, since even antiserum against another known candidate (PhpA protein) (Zhang *et al.*, 2001) that is surface exposed produced much less detectable surface antibody binding in FACS analysis as compared to type 3 cells (data not shown).

The failure to detect surface reactive antibody in the type 14 whole cell ELISA (Table 18) was also most likely due to the growth of the cells or the assay conditions,

because the standard sera employed gave a much lower titer than normally observed.

The RT-PCR data serve to reinforce the potential of the candidate proteins from these ORF's. The data show that *Streptococcus pneumoniae* grown either *in vitro* or *in vivo* produce mRNA specific for the ORFs examined. Since it is known that the ORFs are expressed *in vitro*, it is likely that they are also expressed *in vivo* as well. Experiments are in progress to confirm this using whole cell lysates from *in vivo* grown cells.

Not every ORF analyzed could be shown to be expressed in *Streptococcus pneumoniae*. For example, a protein from ORF 935 was not detected by Western blot analysis, whole cell ELISA (Table 18), or RT-PCR (data not shown). It may be that ORF 935 is only expressed under "real" *in vivo* conditions or that the sequencing of the region is incorrect and the expressed protein is out of frame with the true protein produced by *Streptococcus pneumoniae*.

EXAMPLE 3

STREPTOCOCCUS PNEUMONIAE PROTEOME ANALYSIS

MATERIALS AND METHODS

Bacteria and media. *S. pneumoniae* type III (ATCC #6303) was obtained from the American Type Culture Collection, Manassas, VA. *S. pneumoniae* type 19F was obtained from Dr. Gerald Schiffman, State University of New York, Brooklyn, NY. A glycerol stock plate on Tryptic Soy Agar II (TSA II)/5.0% sheep blood plate (Becton Dickinson Microbiology Systems, Cockeysville, MD) was prepared and incubated overnight, at 37°C in the presence of 5.0% CO_2. Cells from each plate were transferred to 20 ml of Todd-Hewitt Broth/0.5% Yeast Extract (THY) and incubated overnight at 37°C with gentle shaking (10 rpm) in the presence of 5.0% CO_2. For type 3, the culture was then diluted 10 fold with 100 ml of THY. For type 19F, the culture was then diluted 40 fold with 200 ml of THY. Both of these diluted cultures were subsequently incubated under the above conditions. Type 19F required 9 h incubation time to reach a concentration of 1×10^9 cells/ml. Type 3 was incubated overnight and its concentration was not determined.

Isolation of membrane fraction. The bacterial cultures were spun down and washed with PBS/$MgSO_4$ (30 mM sodium phosphate/150 mM NaCl/1 mM $MgSO_4$, pH 6.8). The pellets were resuspended in 4 ml of PBS/$MgSO_4$ containing 5 μg Lysozyme (Sigma Chemical Co., St. Louis, MO), and 400 μg Mutanolysin (Sigma). The samples were incubated at 37°C for 1 hour with shaking. After the incubation, ~300 units of RNAse Cocktail™ (Ambion Inc., Austin, TX) was added to each sample. The samples were centrifuged at low speed using a tabletop centrifuge (2.5 k rpm, 10 min, at 4°C). The supernatant was subsequently spun at high speed to pellet the membrane fractions using a Beckman (Beckman Instruments, Inc., Palo Alto, CA) Model L8-70M Preparative Ultracentrifuge (60Ti rotor, at 40k rpm, 4°C, 1 h). The supernatant was removed and the membrane pellet was washed with PBS/$MgSO_4$.

Trypsin digestion of excised SDS-PAGE gel bands. Mini SDS-PAGE gels (10 cm x 10 cm) were run with precast 10-20% (w/v, acrylamide) gradient gels (Zaxis, Hudson, OH) at 200 V. The See Blue molecular weight standard used was obtained from Invitrogen, Carlsbad, CA. The gels were stained with Simply Blue Safestain, a colloidal Coomassie Blue G250 stain (Invitrogen) as per manufacturer's instructions.

Each sample lane, in its entirety, was cut into 15 different bands. For each sample, bands representing identical molecular weight areas of the gel from three sample lanes, run next to each other, were collected together for further processing. The gel slices were washed twice with 0.5 ml of 50% (v/v) aqueous HPLC grade acetonitrile (Burdick & Jackson, Muskegon, MI) for 5 min with gentle shaking and stored frozen at –20°C following removal of the wash liquid. Frozen gel bands were thawed and cut into 1 mm cubes and subjected to in-gel trypsin digestion using a DigestPro robot (ABIMED Analysen-Technik GmbH, Langenfeld, Germany). In the configuration used, up to 30 samples could be processed simultaneously. The automated protocol consisted of the following steps in order: reduction of the protein in the gel bands with dithiothreitol, alkylation with iodoacetamide, digestion with trypsin and elution of the peptides. Sequencing Grade Modified Trypsin obtained from Promega Corporation, Madison, WI was used. This trypsin is highly specific for hydrolysis of peptide bonds at the carboxylic sides of lysine and arginine residues. It is modified by reductive methylation to make it extremely resistant to autolysis, which can generate pseudotrypsin with chymotrypsin-like specificity. Specificity is further improved by treatment with L-1-chloro-3-tosylamido-4-phenylbutan-2-one (TPCK) followed by affinity purification. The peptide digests were collected, dried using a SpeedVac (Thermo Savant, Holbrook, NY) to ~10 µl, and subsequently diluted to 50 µl with 0.1 M acetic acid. Samples were transferred to plastic autosampler vials, sealed, and injected using a 5 µl sample loop.

Microcapillary LC-Mass Spectrometry. Mass spectral data were acquired on a Thermo Finnigan LCQ DECA quadrupole ion trap mass spectrometer (Thermo Finnigan, San Jose, CA) equipped with a microcapillary reversed-phase HPLC/micro-electrospray interface. Peptide extracts were analyzed on an automated microelectrospray reversed phase HPLC. The microelectrospray interface consisted of a Picofrit fused silica spray needle, 10 cm length by 75 µm ID, 15 µm orifice diameter (New Objective, Cambridge, Massachusetts) packed with 10 µm C_{18} reversed-phase beads (YMC, Wilmington, North Carolina) to a length of 10 cm. The Picofrit needle was mounted in a fiber optic holder (Melles Griot, Irvine, California) held on a base positioned at the front of the mass spectrometer detector. The rear of the column was plumbed through a titanium union to supply an electrical connection for the electrospray interface. The union was connected with a length of

fused silica capillary (FSC) tubing to a FAMOS autosampler (LC-Packings, San Francisco, California) that was connected to an HPLC solvent pump (ABI 140C, Perkin-Elmer, Norwalk, Connecticut). The HPLC solvent pump delivered a flow of 50 μL/min. which was reduced to 250 nl/min. using a PEEK microtight splitting tee (Upchurch Scientific, Oak Harbor, Washington), and then delivered to the autosampler using an FSC transfer line. The HPLC pump and autosampler were each controlled using their internal user programs.

Five microliters of the tryptic digest was separated using the C_{18} microcapillary HPLC column eluting directly into the orifice of the mass spectrometer. Peptides were separated at a flow rate of 250 nl/min using a 50 minute gradient of 4-65% (v/v) acetonitrile in 0.1 M acetic acid. Peptide analyses were conducted on the LCQ-DECA ion trap mass spectrometer operating at a spray voltage of 1.5 kV, and using a heated capillary temperature of 140° C. Data were acquired in automated MS/MS mode using the data acquisition software provided with the instrument. As the peptides elute from the HPLC into the mass spectrometer, they are detected and fragmented in a data dependent manner using "dynamic exclusion". In this technique, the ion trap cycles between full scan and collision induced dissociation (CID) mode, first detecting candidate ions, and then collecting them for fragmentation. Decisions about which ions are going to be fragmented are performed by the instrument "on the fly". The ions, once collected, are then added to an exclusion list and are rejected for a window of two minutes. This technique allows the instrument to distribute its time efficiently when presented with analytes of very high complexity. The operation can result in the collection of as many as 1000 to 2000 fragmentation (CID) spectra in a single run. The acquisition method included 1 MS scan (375-600 m/z) followed by MS/MS scans of the top 2 most abundant ions in the MS scan. The instrument then conducted a second MS scan (600-1000 m/z) followed by MS/MS scans of the top 2 most abundant ions in that scan. The dynamic exclusion and isotope exclusion functions were employed to increase the number of peptide ions that were analyzed (settings: 3 amu = exclusion width, 3 min = exclusion duration, 30 sec = pre-exclusion duration, 3 amu = isotope exclusion width). For the current experiment involving 30 samples, the data was collected in a completely automated fashion over 48 hours using the autosampler.

Sequence database search for identification of proteins from CID spectra. Automated analysis of MS/MS data was performed using the SEQUEST computer algorithm incorporated (Eng, McCormack and Yates, 1994) into the Finnigan Bioworks data analysis package (ThermoFinnigan, San Jose, California) using the protein sequence databases described below. SEQUEST is highly computation intensive, the searches for this study were performed on a dedicated 12 x 600 MHz PC cluster. Peptide matches with Xcorr values greater than 2.0 were loaded into a database for further computational analysis followed by manual verification of the data where necessary (as described below).

RESULTS AND DISCUSSION

Proteomics Based Approach

The term 'proteome' has been defined as the proteins expressed by the genome of an organism or tissue. One of the primary goals of analysis of the proteome or proteomics involves identification of proteins in a large-scale high-throughput format. Bacterial membrane preparations constitute a very important source for surface localized proteins, which are likely candidate antigens. A proteomics based approach was taken to identify the protein components of the complex mixture of proteins contained in the membrane fraction of *Streptococcus pneumoniae*. The study of membrane associated proteins offers a very specific and significant challenge for proteomics. The detergents required to keep these proteins in aqueous solution usually interfere with analytical methods. During two-dimensional (2-D) gel electrophoresis, which has been widely used for the analysis of soluble proteins, severe quantitative loss of membrane proteins is often observed. The problem is more severe when immobilized pH gradients are used in the first dimension. To minimize such solubility problems with membrane preparations from some other bacteria, several sample preparations, as well as some novel zwitterionic detergents were tested; all of which were shown to improve the analysis of membrane proteins by 2-D gel electrophoresis. However, applicants believe their success in identifying the major set of outer membrane proteins was quite limited. In view of this, a novel combination of a very simple and a very complex method for identification of the membrane proteome component of *Streptococcus pneumoniae* has been applied, as described below.

In this approach, the membrane preparation was first separated by sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) using a mini gel format, followed by staining of the gel with a colloidal Coomassie blue stain. Fifteen gel bands containing the entire sample lane were excised and the bands digested individually with trypsin. The tryptic peptides were analyzed using microcapillary reversed-phase liquid chromatography–micro-electrospray tandem mass spectrometry (LC-MS/MS) on a Finnigan LCQ Deca quadrupole ion trap mass spectrometer. Tandem mass spectrometry (MS/MS) has been shown to be a powerful approach to analyze proteins (Eng, McCormack and Yates, 1994). In the first step, MS/MS uses a mass analyzer to separate a peptide ion from a mixture of ions, then uses a second step or mass analyzer to activate and dissociate the ion of interest. This process, known as collision-induced dissociation (CID), causes the peptide to fragment at the peptide bonds between the amino acids, and the fragmentation pattern of a peptide is used to determine its amino acid sequence. The SEQUEST computer algorithm (Eng, McCormack and Yates, 1994) was used to search the uninterpreted experimental fragmentation spectra against protein or translated nucleotide sequence databases to identify the proteins present in each gel band. SEQUEST conceptually digests protein sequences in a database into tryptic peptides and then models them into simulated CID spectra using the known rules of peptide fragmentation. SEQUEST then compares these simulated CID spectra against the experimental spectra and returns a list of probable peptide sequences matching the raw data along with different parameters representing the fidelity of the match. For peptides above roughly 800-900 Dalton in size, a single spectrum can uniquely identify a protein.

To obtain sequence information on multiple peptides from the complex mixture generated by trypsin digestion of the SDS-PAGE gel bands, a reversed phase chromatography system was coupled to an electrospray ion trap mass spectrometer. In this system, it is known that high sensitivity (down to sub-femtomole levels) can be attained by minimizing both flow rate and column diameter to concentrate the elution volume and direct as much of the column effluent as possible into the orifice of the mass spectrometer. To maximize the coverage of proteins present in the sample, the data-dependent acquisition feature of the ion trap was employed. Dynamic exclusion was used to prevent reacquisition of tandem mass

spectra of ions once a spectrum had been acquired for a particular m/z value. Use of these data-dependent features dramatically increased the number of peptide ions that were selected for CID analysis.

The LC-MS/MS data acquisition conditions described above typically resulted in fragmentation data for more than 2000 peptide ions for each run. Using the SEQUEST algorithm, this data was correlated against two protein sequence databases. The first one, SnA6F6, contained open reading frames obtained from translation of *Streptococcus pneumoniae* type 4 genome sequence (TIGR4) in all six reading frames with the smallest peptide containing six amino acid residues. The second one, nr, is a non-redundant GenBank protein sequence database. SEQUEST search conditions used trypsin selectivity for both of the searches. The SnA6F6 search allowed a differential search of +16 Dalton for methionine residues to account for peptides displaying oxidation of methionine.

Candidate matches identified by SEQUEST were confirmed using the following procedure. For each peptide, SEQUEST computes a Xcorr value from cross correlation of the experimental MS/MS spectrum with the candidate peptides in the sequence database. The Xcorr is a measure of the similarity of the experimental MS/MS data to that generated from the sequence database. Peptide matches with Xcorr values greater than 2.0 were selected for further analysis and loaded on to an in-house developed system for analysis of SEQUEST data using the commercially available Oracle® relational database system. Since the SEQUEST output is quite complex, applicants incorporated a new scoring algorithm in Oracle® to calculate a match score for each protein identified as follows:

$$\text{Protein Score} = n \sum(\text{Xcorr}/\text{rank})$$

where the rank is that assigned by SEQUEST for each peptide sequence identified from a specific protein sequence in the database and n is the number of unique peptides identified for that protein, since the same peptide may be identified multiple times in an LC-MS/MS experiment. The fragmentation spectra for all moderate or weak assignments by the software used were checked manually by direct examination of the CID spectra for reasonable signal/noise ratio, and the list of matched ions was also examined for reasonable continuity. Generally three or more spectra converging with reasonable Protein Score (usually >25) or Xcorr values (usually >2.5) onto a single database entry constitutes a convincing identification.

The rationale behind the experimental proteomics approach for characterization of membrane associated proteins of *Streptococcus pneumoniae* was that the single SDS-PAGE step circumvented the solubility complications associated with isoelectric focusing in 2-D gel electrophoresis. It also offered a simple fractionation of the membrane preparation according to molecular weight that reduced the complexity of the samples subjected to LC-MS/MS analysis. The combination of these analytical techniques allowed us to separate and obtain sequence information of multiple peptides with high sensitivity over a large concentration range and identify the corresponding proteins by correlation with sequences in databases. As part of this study, a method for the isolation of membrane preparations from *Streptococcus pneumoniae* was also developed. This involved enzymatic digestion of *Streptococcus pneumoniae* cell walls with mutanolysin and lysozyme in a hypotonic buffer followed by differential centrifugation. The twenty-eight ORFs representing surface exposed proteins were also identified by the proteomic approach and are presented in Table 11. The ORFs representing membrane associated proteins and identified by the proteomic approach are presented in Table 12. Table 14 contains all the open reading frames identified from the SnA6F6 database representing the TIGR4 genomic sequence. Table 14 also contains proteins identified from the nr database search which do not originate from the TIGR4 genome.

Combination of Genomics and Proteomics Approaches

The ORFs identified by proteomics represent surface localized, surface exposed or membrane associated proteins of *Streptococcus pneumoniae*. Those twenty-eight ORFs that support the putative surface exposed ORFs identified by genomics approaches (*i.e.*, Tables 1-10) are listed in Table 11 and provide further evidence of surface localization of these candidates. The 161 novel ORFs identified by proteomics as membrane associated are listed in Table 12.

EXAMPLE 4

IMMUNOGOLD LABELING OF *STREPTOCOCCUS PNEUMONIAE* AND LOW VOLTAGE SCANNING ELECTRON MICROSCOPY

Surface exposure of proteins on *Streptococcus pneumoniae* may also be assessed by immunogold labeling of whole bacteria and electron microscopy.

Bacteria cells are labeled as previously described (Olmsted *et al.*, 1993). Briefly, late-log phase bacterial cultures are washed twice, and resuspended to a concentration of 1 x 10^8 cells/ml in 10 mM phosphate buffered saline (PBS) (pH 7.4) and placed on poly-L-lysine coated glass coverslips. Excess bacteria are gently washed from the coverslips and unlabeled samples are placed into fixative (2.0% glutaraldehyde, in a 0.1 M sodium cacodylate buffer containing 7.5% sucrose) for 30 min. Bacteria to be labeled with colloidal gold are washed with PBS containing 0.5% bovine serum albumin, and the pre-immune or hyper-immune mouse polyclonal antibody prepared above applied for 1 hour at room temperature. Bacteria are then gently washed, and a 1:6 dilution of goat anti-mouse conjugated to 18 nm colloidal gold particles (Jackson ImmunoResearch Laboratories, Inc., West Grove, PA) applied for 10 min at room temperature. Finally, all samples are washed gently with PBS, and placed into the fixative described above. The fixative is washed from samples twice for 10 min in 0.1 M sodium cacodylate buffer, and postfixed for 30 min in 0.1 M sodium cacodylate containing 1% osmium tetroxide. The samples are then washed twice with 0.1 M sodium cacodylate, dehydrated with successive concentrations of ethanol, critical point dried by the CO_2 method of Anderson (Anderson, 1951) using a Samdri-780A (Tousimis, Rockville, MD), and coated with a 1-2 nm discontinuous layer of platinum. *Streptococcus pneumoniae* cells are viewed with a LEO 1550 field emission scanning electron microscope operated at low accelerating voltages (1-4.5 keV) using a secondary electron detector for conventional topographical imaging and a high-resolution Robinson backscatter detector to enhance the visualization of colloidal gold by atomic number contrast.

EXAMPLE 5

IN VITRO OPSONPHAGOCYTOSIS ANALYSIS

An *in vitro* opsonic reaction, that may mimic the *in vivo* reaction, is conducted by incubating together a mixture of *Streptococcus pneumoniae* cells, heat inactivated human serum containing specific antibodies to the pneumococcal strain, and an exogenous complement source. Opsonophagocytosis proceeds during incubation of freshly isolated human polymorphonuclear cells (PMN's) and the antibody/complement/pneumococcal cell mixture. Bacterial cells that are coated with antibody and complement are killed upon opsonophagocytosis. Colony forming units

(cfu) of surviving bacteria that escape from opsonophagocytosis are determined by plating the assay mixture. Titers are reported as the reciprocal of the highest dilution that gives $\geq$ 50% bacterial killing, as determined by comparison to assay controls. Specimens which demonstrate less than 50% killing at the lowest serum dilution tested (1:8), are reported as having an OPA titer of 4. The highest dilution tested is 1:2560. Samples with $\geq$ 50% killing at the highest dilution are repeated, beginning with a higher initial dilution.

The present method is a modification of Gray's method (Gray, B.M. 1990). The assay mixture is assembled in a 96-well microtiter tissue culture plate at room temperature. The assay mixture consists of 10 µL of test serum (a series of two-fold dilutions) heated to 56°C for 30 minutes prior to testing, 10 µL of preclostral bovine serum (complement source) having no opsonic activity for the bacterial test strain, and 20 µL of buffer containing 2000 viable *Streptococcus pneumoniae* organisms. This mixture is incubated at 37°C without CO_2 for 30 minutes with shaking. Next, 40 µL of human PMNs, freshly prepared from heparinized peripheral blood by dextran sedimentation and Percoll density centrifugation, suspended in buffer at a concentration of 1 x 10^6/mL is added. The assay plate(s) are then incubated at 37°C for an additional 90 minutes with vigorous shaking. Aliquots from each well are dispensed onto the upper 1/4 of a 15 x 100 mm blood agar plate. The blood agar plate is tilted while pipetting to allow the liquid suspension to "run" down the plate. Plates are incubated overnight in 5% CO_2 at 37°C. The viable cfu are counted the following morning. Negative control wells, lacking bacterial cells, test serum, complement and/or phagocytes in appropriate combination are included in each assay. A test serum control, which contains test serum plus bacterial cells and heat inactivated complement, is included for each individual serum. This control can be used to assess whether the presence of antibiotics or other serum components are capable of killing the bacterial strain directly (*i.e.* in the absence of complement or PMN's). A human serum with known opsonic titer is used as a positive human serum control. The opsonic antibody titer for each unknown serum is calculated as the reciprocal of the initial dilution of serum giving 50% cfu reduction compared to the control without serum.

EXAMPLE 6

INTRANASAL OR PARENTERAL IMMUNIZATION OF CBA/CAHN MICE PRIOR TO CHALLENGE

Six-week old, pathogen-free, male CBA/CaHN xid/J (CBA/N) mice are purchased from Jackson Laboratories (Bar Harbor, Maine) and housed in cages under standard temperature, humidity, and lighting conditions. CBA/N mice, at 10 animals per group, are immunized with an appropriate amount of the protein(s) to be tested. For parenteral immunization, the protein is mixed with 100 μg of MPL™ per dose to a final volume of 200 μl in saline and then injected subcutaneously (SC) into mice. All groups receive a booster with the same dose and by the same route 3 and 5 weeks after the primary immunization. Control mice are injected with MPL™ alone. All mice are bled two weeks after the last boosting; sera is then isolated and stored at –20°C. For intranasal (IN) immunization, mice receive three IN immunizations, one week apart. On each occasion, an appropriate dose of the protein to be tested is formulated with 0.1 μg of CT-E29H, a genetically modified cholera toxin that is reduced in enzymatic activity and toxicity (Tebbey *et al.*, 2000), and slowly instilled into the nostril of each mouse in a 10 μl volume. Mice immunized with CT-E29H alone are used as controls. Serum samples are collected one week after the last immunization.

EXAMPLE 7

LD_{50} DETERMINATION

Six or 12-week old CBA/N mice (10 per group) are challenged intranasally (IN) with 10 μl of a suspension of streptomycin resistant type 3 *Streptococcus pneumoniae* diluted to 5×10^9 CFU/ml in PBS. Two-fold serial dilutions of this suspension are also tested. The actual doses of bacteria administered are determined by plating dilutions of the inoculum on streptomycin containing tryptic soy agar plates. The LD_{50} is calculated by the Reed-Muench method as discussed by Lennette (Lennette, 1995). The LD_{50} of 13-week old CBA/N mice with type 3 strain was previously shown to be 1×10^5 CFU, while the LD_{50} of 6-week old CBA/N mice was 1×10^4 CFU.

EXAMPLE 8

CBA/CAHN *XID* MOUSE INTRANASAL CHALLENGE MODEL

Mice are challenged with either serotype 3 or serotype 14 streptomycin resistant *Streptococcus pneumoniae*. Pneumococci are inoculated into 3 ml of Todd-Hewitt broth containing 100 μg/ml of streptomycin. The culture is grown at 37°C until mid-log phase, then diluted to the desired concentration with Todd-Hewitt broth and stored on ice until use. Each mouse is anesthetized with 1.2 mg of ketamine HCl (Fort Dodge Laboratory, Ft. Dodge, Iowa) by intraperitoneal (IP) injection. The bacterial suspension is inoculated to the nostril of anesthetized mice (10 μl per mouse). The actual dose of bacteria administered is confirmed by plate count. Two or 3 days after challenge, mice are sacrificed, the noses are removed, and homogenized in 3-ml sterile saline with a tissue homogenizer (Ultra-Turax T25, Janke & Kunkel Ika-Labortechnik, Staufen, Germany). The homogenate is 10-fold serially diluted in saline and plated on streptomycin containing TSA plates. Fifty μl of blood collected 2 days post-challenge from each mouse are also plated on the same kind of plates. Plates are incubated overnight at 37°C and then colonies are counted. CBA/N mice are observed daily after challenge, and the mortality is monitored for 14 days.

EXAMPLE 9

INTRANASAL IMMUNIZATION OF BALB/C MICE PRIOR TO CHALLENGE

Six-week old, pathogen-free, Balb/c mice are purchased from Jackson Laboratories (Bar Harbor, Maine) and housed in cages under standard temperature, humidity, and lighting conditions. BALB/C mice, at 10 animals per group, are immunized with an appropriate amount of the protein to be tested on weeks 0, 2, and 4. On each occasion, the protein being tested is formulated with 0.1 μg of CT-E29H, and slowly instilled into the nostril of each mouse in a 10 μl volume. Mice immunized with Keyhole Limpet Hemocyanin (KLH)-CT-E29H are used as controls. Serum samples are collected 4 days after the last immunization.

EXAMPLE 10

MOUSE INTRANASAL CHALLENGE MODEL

Balb/c mice are challenged on the sixth day of week 4 (*i.e.*, at approximately 27 days) with $1X10^5$ CFU's of serotype 3 streptomycin resistant *Streptococcus pneumoniae*. Pneumococci are inoculated into 3 ml of Todd-Hewitt broth containing 100 µg/ml of streptomycin. The culture is grown at 37°C until mid-log phase, then diluted to the desired concentration with Todd-Hewitt broth and stored on ice until use. Each mouse is anesthetized with 1.2 mg of ketamine HCl (Fort Dodge Laboratory, Ft. Dodge, Iowa) by i.p. injection. The bacterial suspension is inoculated into the nostril of anesthetized mice (10 µl per mouse). The actual dose of bacteria administered is confirmed by plate count. Four days after challenge, mice are sacrificed, the noses removed, and homogenized in 3-ml sterile saline with a tissue homogenizer (Ultra-Turax T25, Janke & Kunkel Ika-Labortechnik, Staufen, Germany). The homogenate is 10-fold serially diluted in saline and plated on streptomycin containing TSA plates. Fifty µl of blood collected 2 days post-challenge from each mouse also is plated on the same kind of plates. Plates are incubated overnight at 37°C and then colonies are counted.

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U.S. Patent 5,766,844
U.S. Patent 5,789,654
U.S. Patent 5,798,209
U.S. Patent 6,201,103
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What is Claimed is:

1. An isolated polynucleotide of a *Streptococcus pneumoniae* genomic sequence, wherein the polynucleotide comprises a nucleotide sequence having at least about 95% identity to a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO:431 through SEQ ID NO:591, a degenerate variant thereof, or a fragment thereof.

2. The polynucleotide of claim 1, wherein the polynucleotide is a complement to a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO:431 through SEQ ID NO:591, a degenerate variant thereof, or a fragment thereof.

3. The polynucleotide of claim 2, wherein the polynucleotide is selected from the group consisting of DNA, chromosomal DNA, cDNA and RNA.

4. The polynucleotide of claim 3, wherein the polynucleotide further comprises heterologous nucleotides.

5. An isolated polynucleotide which hybridizes to a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO:431 through SEQ ID NO:591, a complement thereof, a degenerate variant thereof, or a fragment thereof, under high stringency hybridization conditions.

6. The polynucleotide of claim 5, wherein the polynucleotide hybridizes under intermediate stringency hybridization conditions.

7. An isolated polynucleotide of a *Streptococcus pneumoniae* genomic sequence, wherein the polynucleotide comprises a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO:431 through SEQ ID NO:591, a fragment thereof, or a degenerate variant

thereof, and encodes a polypeptide, a biological equivalent thereof, or a fragment thereof, selected from the group consisting of:

(a) a *Streptococcus pneumoniae* polypeptide having 0, 1 or 2 transmembrane domains;

(b) a *Streptococcus pneumoniae* polypeptide having 3 or more transmembrane domains;

(c) a *Streptococcus pneumoniae* polypeptide having an outer membrane domain or a periplasmic domain;

(d) a *Streptococcus pneumoniae* polypeptide having an inner membrane domain;

(e) a *Streptococcus pneumoniae* polypeptide identified by Blastp analysis;

(f) a *Streptococcus pneumoniae* polypeptide identified by Pfam analysis;

(g) a *Streptococcus pneumoniae* lipoprotein;

(h) a *Streptococcus pneumoniae* polypeptide having a LPXTG motif, wherein the polypeptide is covalently attached to the peptidoglycan layer;

(i) a *Streptococcus pneumoniae* polypeptide having a peptidoglycan binding motif, wherein the polypeptide is associated with the peptidoglycan layer;

(j) a *Streptococcus pneumoniae* polypeptide having a signal sequence and a C-terminal Tyrosine or a C-terminal Phenylalanine amino acid;

(k) a *Streptococcus pneumoniae* polypeptide having a tripeptide RGD amino acid sequence;

(l) a *Streptococcus pneumoniae* polypeptide identified by proteomics as surface exposed;

and

(m) a *Streptococcus pneumoniae* polypeptide identified by proteomics as membrane associated.

8. The polynucleotide of claim 7, wherein the polynucleotide is a complement to a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO:431 through SEQ ID NO:591, a degenerate variant thereof, or a fragment thereof.

9. The polynucleotide of claim 8, wherein the polynucleotide is selected from the group consisting of DNA, chromosomal DNA, cDNA and RNA.

10. The polynucleotide of claim 9, wherein the polynucleotide further comprises heterologous nucleotides.

11. The polynucleotide of claim 10, wherein the polynucleotide encodes a fusion polypeptide.

12. The polynucleotide of claim 7, wherein the polynucleotide encoding a polypeptide having 0, 1 or 2 transmembrane domains comprises a nucleotide sequence chosen from one of SEQ ID NO: 1, SEQ ID NO: 3, SEQ ID NO: 4, SEQ ID NO: 7, SEQ ID NO: 8, SEQ ID NO: 9, SEQ ID NO: 11, SEQ ID NO: 13, SEQ ID NO: 16, SEQ ID NO: 17, SEQ ID NO: 18, SEQ ID NO: 19, SEQ ID NO: 22, SEQ ID NO: 23, SEQ ID NO: 24, SEQ ID NO: 25, SEQ ID NO: 28, SEQ ID NO: 29, SEQ ID NO: 32, SEQ ID NO: 34, SEQ ID NO: 36, SEQ ID NO: 39, SEQ ID NO: 41, SEQ ID NO: 42, SEQ ID NO: 45, SEQ ID NO: 47, SEQ ID NO: 49, SEQ ID NO: 50, SEQ ID NO: 51, SEQ ID NO: 53, SEQ ID NO: 55, SEQ ID NO: 57, SEQ ID NO: 58, SEQ ID NO: 60, SEQ ID NO: 61, SEQ ID NO: 62, SEQ ID NO: 63, SEQ ID NO: 64, SEQ ID NO: 66, SEQ ID NO: 67, SEQ ID NO: 68, SEQ ID NO: 69, SEQ ID NO: 70, SEQ ID NO: 72, SEQ ID NO: 73, SEQ ID NO: 74, SEQ ID NO: 78, SEQ ID NO: 79, SEQ ID NO: 81, SEQ ID NO: 83, SEQ ID NO: 85, SEQ ID NO: 86, SEQ ID NO: 89, SEQ ID NO: 91, SEQ ID NO: 92, SEQ ID NO: 95, SEQ ID NO: 96, SEQ ID NO: 97, SEQ ID NO: 100, SEQ ID NO: 104, SEQ ID NO: 105, SEQ ID NO: 106, SEQ ID NO: 109, SEQ ID NO: 110, SEQ ID NO: 111, SEQ ID NO: 113, SEQ ID NO: 116, SEQ ID NO: 121, SEQ ID NO: 122, SEQ ID NO: 123, SEQ ID NO: 125, SEQ ID NO: 126, SEQ ID NO: 127, SEQ ID NO: 128, SEQ ID NO: 131, SEQ ID NO: 132, SEQ ID NO: 134, SEQ ID NO: 136, SEQ ID NO: 137, SEQ ID NO: 138, SEQ ID NO: 141, SEQ ID NO: 142, SEQ ID NO: 143, SEQ ID NO: 144, SEQ ID NO: 147, SEQ ID NO: 148, SEQ ID NO: 149, SEQ ID NO: 150, SEQ ID NO: 155, SEQ ID NO: 156, SEQ ID NO: 158, SEQ ID

NO: 161, SEQ ID NO: 162, SEQ ID NO: 165, SEQ ID NO: 170, SEQ ID NO: 171, SEQ ID NO: 172, SEQ ID NO: 174, SEQ ID NO: 176, SEQ ID NO: 179, SEQ ID NO: 183, SEQ ID NO: 185, SEQ ID NO: 187, SEQ ID NO: 192, SEQ ID NO: 195, SEQ ID NO: 196, SEQ ID NO: 197, SEQ ID NO: 199, SEQ ID NO: 200, SEQ ID NO: 201, SEQ ID NO: 202, SEQ ID NO: 204, SEQ ID NO: 205, SEQ ID NO: 207, SEQ ID NO: 209 and SEQ ID NO: 210.

13. The polynucleotide of claim 7, wherein the polynucleotide encoding a polypeptide having 3 or more transmembrane domains comprises a nucleotide sequence chosen from one of SEQ ID NO: 2, SEQ ID NO: 5, SEQ ID NO: 6, SEQ ID NO: 10, SEQ ID NO: 12, SEQ ID NO: 14, SEQ ID NO: 15, SEQ ID NO: 20, SEQ ID NO: 21, SEQ ID NO: 26, SEQ ID NO: 27, SEQ ID NO: 30, SEQ ID NO: 31, SEQ ID NO: 33, SEQ ID NO: 35, SEQ ID NO: 37, SEQ ID NO: 38, SEQ ID NO: 40, SEQ ID NO: 43, SEQ ID NO: 44, SEQ ID NO: 46, SEQ ID NO: 48, SEQ ID NO: 52, SEQ ID NO: 54, SEQ ID NO: 56, SEQ ID NO: 59, SEQ ID NO: 65, SEQ ID NO: 71, SEQ ID NO: 75, SEQ ID NO: 76, SEQ ID NO: 77, SEQ ID NO: 80, SEQ ID NO: 82, SEQ ID NO: 84, SEQ ID NO: 87, SEQ ID NO: 88, SEQ ID NO: 90, SEQ ID NO: 93, SEQ ID NO: 94, SEQ ID NO: 98, SEQ ID NO: 99, SEQ ID NO: 101, SEQ ID NO: 102, SEQ ID NO: 103, SEQ ID NO: 107, SEQ ID NO: 108, SEQ ID NO: 112, SEQ ID NO: 114, SEQ ID NO: 115, SEQ ID NO: 117, SEQ ID NO: 118, SEQ ID NO: 119, SEQ ID NO: 120, SEQ ID NO: 124, SEQ ID NO: 129, SEQ ID NO: 130, SEQ ID NO: 133, SEQ ID NO: 135, SEQ ID NO: 139, SEQ ID NO: 140, SEQ ID NO: 145, SEQ ID NO: 146, SEQ ID NO: 151, SEQ ID NO: 152, SEQ ID NO: 153, SEQ ID NO: 154, SEQ ID NO: 157, SEQ ID NO: 159, SEQ ID NO: 160, SEQ ID NO: 163, SEQ ID NO: 164, SEQ ID NO: 166, SEQ ID NO: 167, SEQ ID NO: 168, SEQ ID NO: 169, SEQ ID NO: 173, SEQ ID NO: 175, SEQ ID NO: 177, SEQ ID NO: 178, SEQ ID NO: 180, SEQ ID NO: 181, SEQ ID NO: 182, SEQ ID NO: 184, SEQ ID NO: 186, SEQ ID NO: 188, SEQ ID NO: 189, SEQ ID NO: 190, SEQ ID NO: 191, SEQ ID NO: 193, SEQ ID NO: 194, SEQ ID NO: 198, SEQ ID NO: 203, SEQ ID NO: 206, SEQ ID NO: 208, SEQ ID NO: 211, SEQ ID NO: 212, SEQ ID NO: 213, SEQ ID NO: 214 and SEQ ID NO: 215.

14. The polynucleotide of claim 7, wherein the polynucleotide encoding a polypeptide having an outer membrane domain or a periplasmic domain comprises a nucleotide sequence chosen from one of SEQ ID NO: 3, SEQ ID NO: 8, SEQ ID NO: 9, SEQ ID NO: 23, SEQ ID NO: 39, SEQ ID NO: 50, SEQ ID NO: 62, SEQ ID NO: 67, SEQ ID NO: 78, SEQ ID NO: 85, SEQ ID NO: 125, SEQ ID NO: 134, SEQ ID NO: 147, SEQ ID NO: 165, SEQ ID NO: 172 and SEQ ID NO: 179.

15. The polynucleotide of claim 7, wherein the polynucleotide encoding a polypeptide having an inner membrane domain comprises a nucleotide sequence chosen from one of SEQ ID NO: 2, SEQ ID NO: 5, SEQ ID NO: 6, SEQ ID NO: 7, SEQ ID NO: 10, SEQ ID NO: 11, SEQ ID NO: 12, SEQ ID NO: 13, SEQ ID NO: 14, SEQ ID NO: 15, SEQ ID NO: 16, SEQ ID NO: 17, SEQ ID NO: 19, SEQ ID NO: 20, SEQ ID NO: 21, SEQ ID NO: 22, SEQ ID NO: 26, SEQ ID NO: 27, SEQ ID NO: 28, SEQ ID NO: 29, SEQ ID NO: 30, SEQ ID NO: 31, SEQ ID NO: 32, SEQ ID NO: 33, SEQ ID NO: 34, SEQ ID NO: 35, SEQ ID NO: 36, SEQ ID NO: 37, SEQ ID NO: 38, SEQ ID NO: 40, SEQ ID NO: 43, SEQ ID NO: 44, SEQ ID NO: 46, SEQ ID NO: 47, SEQ ID NO: 48, SEQ ID NO: 51, SEQ ID NO: 52, SEQ ID NO: 53, SEQ ID NO: 54, SEQ ID NO: 56, SEQ ID NO: 59, SEQ ID NO: 60, SEQ ID NO: 61, SEQ ID NO: 65, SEQ ID NO: 68, SEQ ID NO: 69, SEQ ID NO: 70, SEQ ID NO: 71, SEQ ID NO: 73, SEQ ID NO: 75, SEQ ID NO: 76, SEQ ID NO: 77, SEQ ID NO: 79, SEQ ID NO: 80, SEQ ID NO: 81, SEQ ID NO: 82, SEQ ID NO: 83, SEQ ID NO: 84, SEQ ID NO: 86 SEQ ID NO: 87, SEQ ID NO: 88, SEQ ID NO: 90, SEQ ID NO: 91, SEQ ID NO: 93, SEQ ID NO: 94, SEQ ID NO: 95, SEQ ID NO: 96, SEQ ID NO: 97, SEQ ID NO: 98, SEQ ID NO: 99, SEQ ID NO: 100, SEQ ID NO: 101, SEQ ID NO: 102, SEQ ID NO: 103, SEQ ID NO: 105, SEQ ID NO: 106, SEQ ID NO: 107, SEQ ID NO: 108, SEQ ID NO: 109, SEQ ID NO: 112, SEQ ID NO: 113, SEQ ID NO: 114, SEQ ID NO: 115, SEQ ID NO: 117, SEQ ID NO: 118, SEQ ID NO: 119, SEQ ID NO: 120, SEQ ID NO: 121, SEQ ID NO: 122, SEQ ID NO: 123, SEQ ID NO: 124, SEQ ID NO: 126, SEQ ID NO: 127, SEQ ID NO: 128, SEQ ID NO: 129, SEQ ID NO: 130, SEQ ID

NO: 131, SEQ ID NO: 132, SEQ ID NO: 133, SEQ ID NO: 135, SEQ ID NO: 136, SEQ ID NO: 139, SEQ ID NO: 140, SEQ ID NO: 141, SEQ ID NO: 142, SEQ ID NO: 144, SEQ ID NO: 145, SEQ ID NO: 146, SEQ ID NO: 148, SEQ ID NO: 150, SEQ ID NO: 151, SEQ ID NO: 152, SEQ ID NO: 153, SEQ ID NO: 154, SEQ ID NO: 156, SEQ ID NO: 157, SEQ ID NO: 158, SEQ ID NO: 159, SEQ ID NO: 160, SEQ ID NO: 162, SEQ ID NO: 163, SEQ ID NO: 164, SEQ ID NO: 166, SEQ ID NO: 167, SEQ ID NO: 168, SEQ ID NO: 169, SEQ ID NO: 170, SEQ ID NO: 173, SEQ ID NO: 175, SEQ ID NO: 176, SEQ ID NO: 177, SEQ ID NO: 178, SEQ ID NO: 180, SEQ ID NO: 181, SEQ ID NO: 182, SEQ ID NO: 184, SEQ ID NO: 186, SEQ ID NO: 187, SEQ ID NO: 188, SEQ ID NO: 189, SEQ ID NO: 190, SEQ ID NO: 191, SEQ ID NO: 192, SEQ ID NO: 193, SEQ ID NO: 194, SEQ ID NO: 195, SEQ ID NO: 198, SEQ ID NO: 200, SEQ ID NO: 203, SEQ ID NO: 206, SEQ ID NO: 208, SEQ ID NO: 209, SEQ ID NO: 211, SEQ ID NO: 212, SEQ ID NO: 213, SEQ ID NO: 214 and SEQ ID NO: 215.

16. The polynucleotide of claim 7, wherein the polynucleotide encoding a polypeptide identified by Blastp analysis comprises a nucleotide sequence chosen from one of SEQ ID NO: 1, SEQ ID NO: 2, SEQ ID NO: 7, SEQ ID NO: 10, SEQ ID NO: 12, SEQ ID NO: 16, SEQ ID NO: 20, SEQ ID NO: 24, SEQ ID NO: 27, SEQ ID NO: 30, SEQ ID NO: 31, SEQ ID NO: 32, SEQ ID NO: 33, SEQ ID NO: 34, SEQ ID NO: 35, SEQ ID NO: 38, SEQ ID NO: 40, SEQ ID NO: 42, SEQ ID NO: 43, SEQ ID NO: 44, SEQ ID NO: 48, SEQ ID NO: 51, SEQ ID NO: 53, SEQ ID NO: 59, SEQ ID NO: 60, SEQ ID NO: 61, SEQ ID NO: 65, SEQ ID NO: 67, SEQ ID NO: 68, SEQ ID NO: 69, SEQ ID NO: 70, SEQ ID NO: 71, SEQ ID NO: 75, SEQ ID NO: 76, SEQ ID NO: 77, SEQ ID NO: 78, SEQ ID NO: 79, SEQ ID NO: 80, SEQ ID NO: 87, SEQ ID NO: 88, SEQ ID NO: 90, SEQ ID NO: 94, SEQ ID NO: 95, SEQ ID NO: 96, SEQ ID NO: 98, SEQ ID NO: 100, SEQ ID NO: 103, SEQ ID NO: 105, SEQ ID NO: 107, SEQ ID NO: 108, SEQ ID NO: 109, SEQ ID NO: 112, SEQ ID NO: 113, SEQ ID NO: 115, SEQ ID NO: 117, SEQ ID NO: 118, SEQ ID NO: 122, SEQ ID NO: 123, SEQ ID NO: 124, SEQ ID NO: 127, SEQ ID NO: 129, SEQ ID NO: 131, SEQ ID NO: 132, SEQ ID NO: 133, SEQ ID NO: 134, SEQ

ID NO: 135, SEQ ID NO: 136, SEQ ID NO: 138, SEQ ID NO: 139, SEQ ID NO: 141, SEQ ID NO: 144, SEQ ID NO: 146, SEQ ID NO: 147, SEQ ID NO: 151 , SEQ ID NO: 152, SEQ ID NO: 154, SEQ ID NO: 155, SEQ ID NO: 157, SEQ ID NO: 158, SEQ ID NO: 159, SEQ ID NO: 160, SEQ ID NO: 161, SEQ ID NO: 162, SEQ ID NO: 163, SEQ ID NO: 165, SEQ ID NO: 166, SEQ ID NO: 167, SEQ ID NO: 169, SEQ ID NO: 172, SEQ ID NO: 173, SEQ ID NO: 176, SEQ ID NO: 177, SEQ ID NO: 178, SEQ ID NO: 180, SEQ ID NO: 181, SEQ ID NO: 182, SEQ ID NO: 184, SEQ ID NO: 185, SEQ ID NO: 186, SEQ ID NO: 188, SEQ ID NO: 189, SEQ ID NO: 191, SEQ ID NO: 193, SEQ ID NO: 196, SEQ ID NO: 197, SEQ ID NO: 198, SEQ ID NO: 199, SEQ ID NO: 200, SEQ ID NO: 201, SEQ ID NO: 202, SEQ ID NO: 204, SEQ ID NO: 205, SEQ ID NO: 206, SEQ ID NO: 207, SEQ ID NO: 208, SEQ ID NO: 210, SEQ ID NO: 212, SEQ ID NO: 213 and SEQ ID NO: 214.

17. The polynucleotide of claim 7, wherein the polynucleotide encoding a polypeptide identified by Pfam analysis comprises a nucleotide sequence chosen from one of SEQ ID NO: 4, SEQ ID NO: 18, SEQ ID NO: 19, SEQ ID NO: 41, SEQ ID NO: 45, SEQ ID NO: 55, SEQ ID NO: 57, SEQ ID NO: 58, SEQ ID NO: 63, SEQ ID NO: 64, SEQ ID NO: 66, SEQ ID NO: 72, SEQ ID NO: 74, SEQ ID NO: 89, SEQ ID NO: 92, SEQ ID NO: 104, SEQ ID NO: 111, SEQ ID NO: 116, SEQ ID NO: 119, SEQ ID NO: 128, SEQ ID NO: 137, SEQ ID NO: 142, SEQ ID NO: 143, SEQ ID NO: 149, SEQ ID NO: 151, SEQ ID NO: 152, SEQ ID NO: 153, SEQ ID NO: 157, SEQ ID NO: 159, SEQ ID NO: 160, SEQ ID NO: 162, SEQ ID NO: 163, SEQ ID NO: 164, SEQ ID NO: 165, SEQ ID NO: 166, SEQ ID NO: 169, SEQ ID NO: 171, SEQ ID NO: 174, SEQ ID NO: 176, SEQ ID NO: 180, SEQ ID NO: 182, SEQ ID NO: 183, SEQ ID NO: 184, SEQ ID NO: 186, SEQ ID NO: 188, SEQ ID NO 189, SEQ ID NO: 195, SEQ ID NO: 198, SEQ ID NO 199, SEQ ID NO: 205, SEQ ID NO: 212 and SEQ ID NO: 213.

18. The polynucleotide of claim 7, wherein the polynucleotide encoding a lipoprotein comprises a nucleotide sequence chosen from one of SEQ ID NO: 3, SEQ ID NO: 8, SEQ ID NO: 9, SEQ ID NO: 13, SEQ ID NO: 21, SEQ ID

NO: 26, SEQ ID NO: 34, SEQ ID NO: 62, SEQ ID NO: 67, SEQ ID NO: 85, SEQ ID NO: 134, SEQ ID NO: 147, SEQ ID NO: 150, SEQ ID NO: 168, SEQ ID NO: 170 and SEQ ID NO: 173.

19. The polynucleotide of claim 7, wherein the polynucleotide encoding a polypeptide having a LPXTG motif and covalently attached to the peptidoglycan layer comprises a nucleotide sequence chosen from one of SEQ ID NO: 13, SEQ ID NO: 21, SEQ ID NO: 34 and SEQ ID NO: 170.

20. The polynucleotide of claim 7, wherein the polynucleotide encoding a polypeptide having a peptidoglycan binding motif and associated with the peptidoglycan layer comprises a nucleotide sequence chosen from one of SEQ ID NO: 25, SEQ ID NO: 49 and SEQ ID NO: 110.

21. The polynucleotide of claim 7, wherein the polynucleotide encoding a polypeptide having a signal sequence and a C-terminal Tyrosine or a C-terminal Phenylalanine amino acid comprises a nucleotide sequence chosen from one of SEQ ID NO:11, SEQ ID NO:39, SEQ ID NO:73, SEQ ID NO:97, SEQ ID NO:106, SEQ ID NO: 125 and SEQ ID NO:187.

22. The polynucleotide of claim 7, wherein the polynucleotide encoding a polypeptide having a tripeptide RGD amino acid sequence comprises a nucleotide sequence chosen from one of SEQ ID NO:1, SEQ ID NO:21, SEQ ID NO:66 and SEQ ID NO:67.

23. The polynucleotide of claim 7, wherein the polynucleotide encoding a polypeptide identified by proteomics as surface exposed comprises a nucleotide sequence chosen from one of SEQ ID NO:14, SEQ ID NO:16, SEQ ID NO:17, SEQ ID NO:46, SEQ ID NO:64, SEQ ID NO:66, SEQ ID NO:67, SEQ ID NO:69, SEQ ID NO:71, SEQ ID NO:74, SEQ ID NO:91, SEQ ID NO:103, SEQ ID NO:116, SEQ ID NO:128, SEQ ID NO:131, SEQ ID NO:136, SEQ ID NO:151, SEQ ID NO:156, SEQ ID NO:159, SEQ ID NO:162,

SEQ ID NO:164, SEQ ID NO:172, SEQ ID NO:176, SEQ ID NO:178, SEQ ID NO:179, SEQ ID NO:180, SEQ ID NO:182 and SEQ ID NO:205.

24. The polynucleotide of claim 7, wherein the polynucleotide encoding a polypeptide identified by proteomics as membrane associated comprises a nucleotide sequence chosen from of one of SEQ ID NO:431 through SEQ ID NO: 591.

25. An isolated polypeptide encoded by a polynucleotide of a *Streptococcus pneumoniae* genomic sequence, wherein the polynucleotide comprises a nucleotide sequence having at least about 95% identity to a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591, a degenerate variant thereof, or a fragment thereof.

26. The polypeptide of claim 25, wherein the polypeptide is a fusion polypeptide.

27. The polypeptide of claim 25, which immunoreacts with seropositive serum of an individual infected with *Streptococcus pneumoniae.*

28. The polypeptide of claim 25, further defined as:
   (a) a *Streptococcus pneumoniae* polypeptide having 0, 1 or 2 transmembrane domains;
   (b) a *Streptococcus pneumoniae* polypeptide having 3 or more transmembrane domains;
   (c) a *Streptococcus pneumoniae* polypeptide having an outer membrane domain or a periplasmic domain;
   (d) a *Streptococcus pneumoniae* polypeptide having an inner membrane domain;
   (e) a *Streptococcus pneumoniae* polypeptide identified by Blastp analysis;
   (f) a *Streptococcus pneumoniae* polypeptide identified by Pfam analysis;
   (g) a *Streptococcus pneumoniae* lipoprotein;

(h) a *Streptococcus pneumoniae* polypeptide having a LPXTG motif, wherein the polypeptide is covalently attached to the peptidoglycan layer;

(i) a *Streptococcus pneumoniae* polypeptide having a peptidoglycan binding motif, wherein the polypeptide is associated with the peptidoglycan layer;

(j) a *Streptococcus pneumoniae* polypeptide having a signal sequence and a C-terminal Tyrosine or a C-terminal Phenylalanine amino acid;

(k) a *Streptococcus pneumoniae* polypeptide having a tripeptide RGD amino acid sequence;

(l) a *Streptococcus pneumoniae* polypeptide identified by proteomics as surface exposed;

and

(m) a *Streptococcus pneumoniae* polypeptide identified by proteomics as membrane associated.

29. The polypeptide of claim 28, wherein the polypeptide having 0, 1 or 2 transmembrane domains comprises an amino acid sequence chosen from one of SEQ ID NO: 216, SEQ ID NO: 218, SEQ ID NO: 219, SEQ ID NO: 222, SEQ ID NO: 223, SEQ ID NO: 224, SEQ ID NO: 226, SEQ ID NO: 228, SEQ ID NO: 231, SEQ ID NO: 232, SEQ ID NO: 233, SEQ ID NO: 234, SEQ ID NO: 237, SEQ ID NO: 238, SEQ ID NO: 239, SEQ ID NO: 240, SEQ ID NO: 243, SEQ ID NO: 244, SEQ ID NO: 247, SEQ ID NO: 249, SEQ ID NO: 251, SEQ ID NO: 254, SEQ ID NO: 256, SEQ ID NO: 257, SEQ ID NO: 260, SEQ ID NO: 262, SEQ ID NO: 264, SEQ ID NO: 265, SEQ ID NO: 266, SEQ ID NO: 268, SEQ ID NO: 270, SEQ ID NO: 272, SEQ ID NO: 273, SEQ ID NO: 275, SEQ ID NO: 276, SEQ ID NO: 277, SEQ ID NO: 278, SEQ ID NO: 279, SEQ ID NO: 281, SEQ ID NO: 282, SEQ ID NO: 283, SEQ ID NO: 284, SEQ ID NO: 285, SEQ ID NO: 286, SEQ ID NO: 287, SEQ ID NO: 289, SEQ ID NO: 293, SEQ ID NO: 294, SEQ ID NO: 296, SEQ ID NO: 298, SEQ ID NO: 300, SEQ ID NO: 301, SEQ ID NO: 304, SEQ ID NO: 306, SEQ ID NO: 307, SEQ ID NO: 310, SEQ ID NO: 311, SEQ ID NO: 312, SEQ ID NO: 315, SEQ ID NO: 319, SEQ ID NO: 320, SEQ ID NO: 321, SEQ ID NO: 324, SEQ

ID NO: 325, SEQ ID NO: 326, SEQ ID NO: 328, SEQ ID NO: 331, SEQ ID NO: 336, SEQ ID NO: 337, SEQ ID NO: 338, SEQ ID NO: 340, SEQ ID NO: 341, SEQ ID NO: 342, SEQ ID NO: 343, SEQ ID NO: 346, SEQ ID NO: 347, SEQ ID NO: 349, SEQ ID NO: 351, SEQ ID NO: 352, SEQ ID NO: 353, SEQ ID NO: 356, SEQ ID NO: 357, SEQ ID NO: 358, SEQ ID NO: 359, SEQ ID NO: 362, SEQ ID NO: 363, SEQ ID NO: 364, SEQ ID NO: 365, SEQ ID NO: 370, SEQ ID NO: 371, SEQ ID NO: 373, SEQ ID NO: 376, SEQ ID NO: 377, SEQ ID NO: 380, SEQ ID NO: 385, SEQ ID NO: 386, SEQ ID NO: 387, SEQ ID NO: 389, SEQ ID NO: 391, SEQ ID NO: 394, SEQ ID NO: 398, SEQ ID NO: 400, SEQ ID NO: 402, SEQ ID NO: 407, SEQ ID NO: 410, SEQ ID NO: 411, SEQ ID NO: 412, SEQ ID NO: 414, SEQ ID NO: 415, SEQ ID NO: 416, SEQ ID NO: 417, SEQ ID NO: 419, SEQ ID NO: 420, SEQ ID NO: 422, SEQ ID NO: 424, SEQ ID NO: 425, a fragment thereof or a degenerate variant thereof.

30. The polypeptide of claim 28, wherein the polypeptide having 3 or more transmembrane domains comprises an amino acid sequence chosen from one of SEQ ID NO: 217, SEQ ID NO: 220, SEQ ID NO: 221, SEQ ID NO: 225, SEQ ID NO: 227, SEQ ID NO: 229, SEQ ID NO: 230, SEQ ID NO: 235, SEQ ID NO: 236, SEQ ID NO: 241, SEQ ID NO: 242, SEQ ID NO: 245, SEQ ID NO: 246, SEQ ID NO: 248, SEQ ID NO: 250, SEQ ID NO: 252, SEQ ID NO: 253, SEQ ID NO: 255, SEQ ID NO: 258, SEQ ID NO: 259, SEQ ID NO: 261, SEQ ID NO: 263, SEQ ID NO: 267, SEQ ID NO: 269, SEQ ID NO: 271, SEQ ID NO: 274, SEQ ID NO: 280, SEQ ID NO: 286, SEQ ID NO: 290, SEQ ID NO: 291, SEQ ID NO: 292, SEQ ID NO: 295, SEQ ID NO: 297, SEQ ID NO: 299, SEQ ID NO: 302, SEQ ID NO: 303, SEQ ID NO: 305, SEQ ID NO: 308, SEQ ID NO: 309, SEQ ID NO: 313, SEQ ID NO: 314, SEQ ID NO: 316, SEQ ID NO: 317, SEQ ID NO: 318, SEQ ID NO: 322, SEQ ID NO: 323, SEQ ID NO: 327, SEQ ID NO: 329, SEQ ID NO: 330, SEQ ID NO: 332, SEQ ID NO: 333, SEQ ID NO: 334, SEQ ID NO: 335, SEQ ID NO: 339, SEQ ID NO: 344, SEQ ID NO: 345, SEQ ID NO: 348, SEQ ID NO: 350, SEQ ID NO: 354, SEQ ID NO: 355, SEQ ID NO: 360, SEQ ID NO: 361, SEQ ID NO: 366, SEQ ID NO: 367, SEQ ID NO: 368, SEQ ID NO: 369, SEQ ID NO: 372, SEQ ID

NO: 374, SEQ ID NO: 375, SEQ ID NO: 378, SEQ ID NO: 379, SEQ ID NO: 381, SEQ ID NO: 382, SEQ ID NO: 383, SEQ ID NO: 384, SEQ ID NO: 388, SEQ ID NO: 390, SEQ ID NO: 392, SEQ ID NO: 393, SEQ ID NO: 395, SEQ ID NO: 396, SEQ ID NO: 397, SEQ ID NO: 399, SEQ ID NO: 401, SEQ ID NO: 403, SEQ ID NO: 404, SEQ ID NO: 405, SEQ ID NO: 406, SEQ ID NO: 408, SEQ ID NO: 409, SEQ ID NO: 413, SEQ ID NO: 418, SEQ ID NO: 421, SEQ ID NO: 423, SEQ ID NO: 426, SEQ ID NO: 427, SEQ ID NO: 428, SEQ ID NO: 429, SEQ ID NO: 430, a fragment thereof or a degenerate variant thereof.

31. The polypeptide of claim 28, wherein the polypeptide having an outer membrane or a periplasmic domain comprises an amino acid sequence chosen from one of SEQ ID NO: 218, SEQ ID NO: 223, SEQ ID NO: 224, SEQ ID NO: 238, SEQ ID NO: 254, SEQ ID NO: 265, SEQ ID NO: 277, SEQ ID NO: 282, SEQ ID NO: 293, SEQ ID NO: 300, SEQ ID NO: 340, SEQ ID NO: 349, SEQ ID NO: 362, SEQ ID NO: 380, SEQ ID NO: 387, SEQ ID NO: 394, a fragment thereof or a degenerate variant thereof.

32. The polypeptide of claim 28, wherein the polypeptide having an inner membrane domain comprises an amino acid sequence chosen from one of SEQ ID NO: 217, SEQ ID NO: 220, SEQ ID NO: 221, SEQ ID NO: 222, SEQ ID NO: 225, SEQ ID NO: 226, SEQ ID NO: 227, SEQ ID NO: 228, SEQ ID NO: 229, SEQ ID NO: 230, SEQ ID NO: 231, SEQ ID NO: 232, SEQ ID NO: 234, SEQ ID NO: 235, SEQ ID NO: 236, SEQ ID NO: 237, SEQ ID NO: 241, SEQ ID NO: 242, SEQ ID NO: 243, SEQ ID NO: 244, SEQ ID NO: 245, SEQ ID NO: 246, SEQ ID NO: 247, SEQ ID NO: 248, SEQ ID NO: 249, SEQ ID NO: 250, SEQ ID NO: 251, SEQ ID NO: 252, SEQ ID NO: 253, SEQ ID NO: 255, SEQ ID NO: 258, SEQ ID NO: 259, SEQ ID NO: 261, SEQ ID NO: 262, SEQ ID NO: 263, SEQ ID NO: 266, SEQ ID NO: 267, SEQ ID NO: 268, SEQ ID NO: 269, SEQ ID NO: 271, SEQ ID NO: 274, SEQ ID NO: 275, SEQ ID NO: 276, SEQ ID NO: 280, SEQ ID NO: 283, SEQ ID NO: 284, SEQ ID NO: 285, SEQ ID NO: 286, SEQ ID NO: 288, SEQ ID NO: 290, SEQ ID NO: 291, SEQ ID NO: 292, SEQ ID NO: 294, SEQ ID NO: 295, SEQ ID NO: 296, SEQ

ID NO: 297, SEQ ID NO: 298, SEQ ID NO: 299, SEQ ID NO: 301 SEQ ID NO: 302, SEQ ID NO: 303, SEQ ID NO: 305, SEQ ID NO: 306, SEQ ID NO: 308, SEQ ID NO: 309, SEQ ID NO: 310, SEQ ID NO: 311, SEQ ID NO: 312, SEQ ID NO: 313, SEQ ID NO: 314, SEQ ID NO: 315, SEQ ID NO: 316, SEQ ID NO: 317, SEQ ID NO: 318, SEQ ID NO: 320, SEQ ID NO: 321, SEQ ID NO: 322, SEQ ID NO: 323, SEQ ID NO: 324, SEQ ID NO: 327, SEQ ID NO: 328, SEQ ID NO: 329, SEQ ID NO: 330, SEQ ID NO: 332, SEQ ID NO: 333, SEQ ID NO: 334, SEQ ID NO: 335, SEQ ID NO: 336, SEQ ID NO: 337, SEQ ID NO: 338, SEQ ID NO: 339, SEQ ID NO: 341, SEQ ID NO: 342, SEQ ID NO: 343, SEQ ID NO: 344, SEQ ID NO: 345, SEQ ID NO: 346, SEQ ID NO: 347, SEQ ID NO: 348, SEQ ID NO: 350, SEQ ID NO: 351, SEQ ID NO: 354, SEQ ID NO: 355, SEQ ID NO: 356, SEQ ID NO: 357, SEQ ID NO: 359, SEQ ID NO: 360, SEQ ID NO: 361, SEQ ID NO: 362, SEQ ID NO: 365, SEQ ID NO: 366, SEQ ID NO: 367, SEQ ID NO: 368, SEQ ID NO: 369, SEQ ID NO: 371, SEQ ID NO: 372, SEQ ID NO: 373, SEQ ID NO: 374, SEQ ID NO: 375, SEQ ID NO: 377, SEQ ID NO: 378, SEQ ID NO: 379, SEQ ID NO: 381, SEQ ID NO: 382, SEQ ID NO: 383, SEQ ID NO: 384, SEQ ID NO: 385, SEQ ID NO: 388, SEQ ID NO: 390, SEQ ID NO: 391, SEQ ID NO: 392, SEQ ID NO: 393, SEQ ID NO: 395, SEQ ID NO: 396, SEQ ID NO: 397, SEQ ID NO: 399, SEQ ID NO: 401, SEQ ID NO: 402, SEQ ID NO: 403, SEQ ID NO: 404, SEQ ID NO: 405, SEQ ID NO: 406, SEQ ID NO: 407, SEQ ID NO: 408, SEQ ID NO: 409, SEQ ID NO: 410, SEQ ID NO: 413, SEQ ID NO: 415, SEQ ID NO: 418, SEQ ID NO: 421, SEQ ID NO: 423, SEQ ID NO: 424, SEQ ID NO: 426, SEQ ID NO: 427, SEQ ID NO: 428, SEQ ID NO: 429, SEQ ID NO: 430, a fragment thereof or a degenerate variant thereof.

33. The polypeptide of claim 28, wherein the polypeptide identified by Blastp analysis comprises an amino acid sequence chosen from one of SEQ ID NO: 216, SEQ ID NO: 217, SEQ ID NO: 222, SEQ ID NO: 225, SEQ ID NO: 227, SEQ ID NO: 231, SEQ ID NO: 235, SEQ ID NO: 239, SEQ ID NO: 242, SEQ ID NO: 245, SEQ ID NO: 246, SEQ ID NO: 247, SEQ ID NO: 248, SEQ ID NO: 249, SEQ ID NO: 250, SEQ ID NO: 253, SEQ ID NO: 255, SEQ ID NO: 257, SEQ ID NO: 258, SEQ ID NO: 259, SEQ ID NO: 263, SEQ ID NO: 266,

SEQ ID NO: 268, SEQ ID NO: 269, SEQ ID NO: 275, SEQ ID NO: 276, SEQ ID NO: 280, SEQ ID NO: 282, SEQ ID NO: 283, SEQ ID NO: 284, SEQ ID NO: 285, SEQ ID NO: 286, SEQ ID NO: 290, SEQ ID NO: 291, SEQ ID NO: 292, SEQ ID NO: 293, SEQ ID NO: 294, SEQ ID NO: 295, SEQ ID NO: 302, SEQ ID NO: 303, SEQ ID NO: 305, SEQ ID NO: 309, SEQ ID NO: 310, SEQ ID NO: 311, SEQ ID NO: 313, SEQ ID NO: 315, SEQ ID NO: 318, SEQ ID NO: 320, SEQ ID NO: 322, SEQ ID NO: 323, SEQ ID NO: 324, SEQ ID NO: 327, SEQ ID NO: 328, SEQ ID NO: 330, SEQ ID NO: 332, SEQ ID NO: 333, SEQ ID NO: 337, SEQ ID NO: 338, SEQ ID NO: 339, SEQ ID NO: 342, SEQ ID NO: 344, SEQ ID NO: 346, SEQ ID NO: 347, SEQ ID NO: 348, SEQ ID NO: 349, SEQ ID NO: 350, SEQ ID NO: 351, SEQ ID NO: 353, SEQ ID NO: 354, SEQ ID NO: 356, SEQ ID NO: 359, SEQ ID NO: 361, SEQ ID NO: 362, SEQ ID NO: 366 , SEQ ID NO: 367, SEQ ID NO: 369, SEQ ID NO: 370, SEQ ID NO: 372, SEQ ID NO: 373, SEQ ID NO: 374, SEQ ID NO: 375, SEQ ID NO: 376, SEQ ID NO: 377, SEQ ID NO: 378, SEQ ID NO: 380, SEQ ID NO: 381, SEQ ID NO: 382, SEQ ID NO: 384, SEQ ID NO: 387, SEQ ID NO: 388, SEQ ID NO: 391, SEQ ID NO: 392, SEQ ID NO: 393, SEQ ID NO: 395, SEQ ID NO: 396, SEQ ID NO: 397, SEQ ID NO: 399, SEQ ID NO: 400, SEQ ID NO: 401, SEQ ID NO: 403, SEQ ID NO: 404, SEQ ID NO: 406, SEQ ID NO: 408, SEQ ID NO: 411, SEQ ID NO: 412, SEQ ID NO: 413, SEQ ID NO: 414, SEQ ID NO: 415, SEQ ID NO: 416, SEQ ID NO: 417, SEQ ID NO: 419, SEQ ID NO: 420, SEQ ID NO: 421, SEQ ID NO: 422, SEQ ID NO: 423, SEQ ID NO: 425, SEQ ID NO: 427, SEQ ID NO: 428, SEQ ID NO: 429, a fragment thereof or a degenerate variant thereof.

34. The polypeptide of claim 28, wherein the polypeptide identified by Pfam analysis comprises an amino acid sequence chosen from one of SEQ ID NO: 219, SEQ ID NO: 233, SEQ ID NO: 234, SEQ ID NO: 255, SEQ ID NO: 260, SEQ ID NO: 270, SEQ ID NO: 272, SEQ ID NO: 273, SEQ ID NO: 278, SEQ ID NO: 279, SEQ ID NO: 281, SEQ ID NO: 287, SEQ ID NO: 289, SEQ ID NO: 304, SEQ ID NO: 307, SEQ ID NO: 319, SEQ ID NO: 326, SEQ ID NO: 331, SEQ ID NO: 334, SEQ ID NO: 343, SEQ ID NO: 352, SEQ ID NO: 357, SEQ ID NO: 358, SEQ ID NO: 364, SEQ ID NO: 366, SEQ ID NO: 367, SEQ

ID NO: 368, SEQ ID NO: 372, SEQ ID NO: 374, SEQ ID NO: 375, SEQ ID NO: 377, SEQ ID NO: 378, SEQ ID NO: 379, SEQ ID NO: 380, SEQ ID NO: 381, SEQ ID NO: 384, SEQ ID NO: 386, SEQ ID NO: 389, SEQ ID NO: 391, SEQ ID NO: 395, SEQ ID NO: 397, SEQ ID NO: 398, SEQ ID NO: 399, SEQ ID NO: 401, SEQ ID NO: 403, SEQ ID NO 404, SEQ ID NO: 410, SEQ ID NO: 413, SEQ ID NO 414, SEQ ID NO: 420, SEQ ID NO: 427, SEQ ID NO: 428, a fragment thereof or a degenerate variant thereof.

35. The polypeptide of claim 28, wherein the polypeptide is a lipoprotein and comprises an amino acid sequence chosen from one of SEQ ID NO: 218, SEQ ID NO: 223, SEQ ID NO: 224, SEQ ID NO: 228, SEQ ID NO: 236, SEQ ID NO: 241, SEQ ID NO: 249, SEQ ID NO: 277, SEQ ID NO: 282, SEQ ID NO: 300, SEQ ID NO: 349, SEQ ID NO: 362, SEQ ID NO: 365, SEQ ID NO: 383, SEQ ID NO: 385, SEQ ID NO: 388, a fragment thereof or a degenerate variant thereof.

36. The polypeptide of claim 28, wherein the polypeptide having a LPXTG motif and covalently attached to the peptidoglycan layer comprises an amino acid sequence chosen from one of SEQ ID NO: 228, SEQ ID NO: 236, SEQ ID NO: 249, SEQ, SEQ ID NO: 385, a fragment thereof or a degenerate variant thereof.

37. The polypeptide of claim 28, wherein the polypeptide having a peptidoglycan binding motif and associated with the peptidoglycan layer comprises an amino acid sequence selected from one of SEQ ID NO: 240, SEQ ID NO: 264, SEQ ID NO: 325, a fragment thereof or a degenerate variant thereof.

38. The polypeptide of claim 28, wherein the polypeptide having a signal sequence and a C-terminal Tyrosine or Phenylalanine amino acid comprises an amino acid sequence chosen from one of SEQ ID NO:226, SEQ ID NO:254, SEQ ID NO:289, SEQ ID NO:312, SEQ ID NO:321, SEQ ID NO: 340, SEQ ID NO:402, a fragment thereof or a degenerate variant thereof.

39. The polypeptide of claim 28, wherein the polypeptide having a tripeptide RGD sequence that potentially is involved in cell attachment comprises an amino acid sequence chosen from one of SEQ ID NO:216, SEQ ID NO:236, SEQ ID NO:281, SEQ ID NO:282, a fragment thereof or a degenerate variant thereof.

40. The polypeptide of claim 28, wherein the polypeptide identified by proteomics as surface exposed comprises an amino acid sequence chosen from one of SEQ ID NO: 229, SEQ ID NO: 231, SEQ ID NO: 232, SEQ ID NO: 261, SEQ ID NO: 279, SEQ ID NO: 281, SEQ ID NO: 282, SEQ ID NO: 284, SEQ ID NO: 286, SEQ ID NO: 289, SEQ ID NO: 306, SEQ ID NO: 318, SEQ ID NO: 331, SEQ ID NO: 343, SEQ ID NO: 346, SEQ ID NO: 351, SEQ ID NO: 366, SEQ ID NO: 371, SEQ ID NO: 374, SEQ ID NO: 377, SEQ ID NO: 379, SEQ ID NO: 387, SEQ ID NO: 391, SEQ ID NO: 393, SEQ ID NO: 394, 395, SEQ ID NO: 397, SEQ ID NO: 420, a fragment thereof or a degenerate variant thereof.

41. The polypeptide of claim 28, wherein the polypeptide identified by proteomics as surface exposed comprises an amino acid sequence chosen from one of SEQ ID NO:592 through SEQ ID NO: 752, a fragment thereof or a degenerate variant thereof.

42. An isolated polypeptide comprising an amino acid sequence having at least about 95% identity to an amino acid sequence chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO:752.

43. The polypeptide of claim 42, wherein the polypeptide is a fusion polypeptide

44. The polypeptide of claim 42, which immunoreacts with seropositive serum of an individual infected with *Streptococcus pneumoniae.*

45. The polypeptide of claim 42, further defined as:

(a) a *Streptococcus pneumoniae* polypeptide having 0, 1 or 2 transmembrane domains;

(b) a *Streptococcus pneumoniae* polypeptide having 3 or more transmembrane domains;

(c) a *Streptococcus pneumoniae* polypeptide having an outer membrane domain or a periplasmic domain;

(d) a *Streptococcus pneumoniae* polypeptide having an inner membrane domain;

(e) a *Streptococcus pneumoniae* polypeptide identified by Blastp analysis;

(f) a *Streptococcus pneumoniae* polypeptide identified by Pfam analysis;

(g) a *Streptococcus pneumoniae* lipoprotein;

(h) a *Streptococcus pneumoniae* polypeptide having a LPXTG motif, wherein the polypeptide is covalently attached to the peptidoglycan layer;

(i) a *Streptococcus pneumoniae* polypeptide having a peptidoglycan binding motif, wherein the polypeptide is associated with the peptidoglycan layer;

(j) a *Streptococcus pneumoniae* polypeptide having a signal sequence and a C-terminal Tyrosine or a C-terminal Phenylalanine amino acid;

(k) a *Streptococcus pneumoniae* polypeptide having a tripeptide RGD amino acid sequence;

(l) a *Streptococcus pneumoniae* polypeptide identified by proteomics as surface exposed;

and

(m) a *Streptococcus pneumoniae* polypeptide identified by proteomics as membrane associated.

46. The polypeptide of claim 45, wherein the polypeptide having a 0, 1 or 2 transmembrane domains comprises an amino acid sequence chosen from one of SEQ ID NO: 216, SEQ ID NO: 218, SEQ ID NO: 219, SEQ ID NO: 222, SEQ ID NO: 223, SEQ ID NO: 224, SEQ ID NO: 226, SEQ ID NO: 228, SEQ ID NO: 231, SEQ ID NO: 232, SEQ ID NO: 233, SEQ ID NO: 234, SEQ ID NO: 237, SEQ ID NO: 238, SEQ ID NO: 239, SEQ ID NO: 240, SEQ ID NO: 243, SEQ ID NO: 244, SEQ ID NO: 247, SEQ ID NO: 249, SEQ ID NO:

251, SEQ ID NO: 254, SEQ ID NO: 256, SEQ ID NO: 257, SEQ ID NO: 260, SEQ ID NO: 262, SEQ ID NO: 264, SEQ ID NO: 265, SEQ ID NO: 266, SEQ ID NO: 268, SEQ ID NO: 270, SEQ ID NO: 272, SEQ ID NO: 273, SEQ ID NO: 275, SEQ ID NO: 276, SEQ ID NO: 277, SEQ ID NO: 278, SEQ ID NO: 279, SEQ ID NO: 281, SEQ ID NO: 282, SEQ ID NO: 283, SEQ ID NO: 284, SEQ ID NO: 285, SEQ ID NO: 286, SEQ ID NO: 287, SEQ ID NO: 289, SEQ ID NO: 293, SEQ ID NO: 294, SEQ ID NO: 296, SEQ ID NO: 298, SEQ ID NO: 300, SEQ ID NO: 301, SEQ ID NO: 304, SEQ ID NO: 306, SEQ ID NO: 307, SEQ ID NO: 310, SEQ ID NO: 311, SEQ ID NO: 312, SEQ ID NO: 315, SEQ ID NO: 319, SEQ ID NO: 320, SEQ ID NO: 321, SEQ ID NO: 324, SEQ ID NO: 325, SEQ ID NO: 326, SEQ ID NO: 328, SEQ ID NO: 331, SEQ ID NO: 336, SEQ ID NO: 337, SEQ ID NO: 338, SEQ ID NO: 340, SEQ ID NO: 341, SEQ ID NO: 342, SEQ ID NO: 343, SEQ ID NO: 346, SEQ ID NO: 347, SEQ ID NO: 349, SEQ ID NO: 351, SEQ ID NO: 352, SEQ ID NO: 353, SEQ ID NO: 356, SEQ ID NO: 357, SEQ ID NO: 358, SEQ ID NO: 359, SEQ ID NO: 362, SEQ ID NO: 363, SEQ ID NO: 364, SEQ ID NO: 365, SEQ ID NO: 370, SEQ ID NO: 371, SEQ ID NO: 373, SEQ ID NO: 376, SEQ ID NO: 377, SEQ ID NO: 380, SEQ ID NO: 385, SEQ ID NO: 386, SEQ ID NO: 387, SEQ ID NO: 389, SEQ ID NO: 391, SEQ ID NO: 394, SEQ ID NO: 398, SEQ ID NO: 400, SEQ ID NO: 402, SEQ ID NO: 407, SEQ ID NO: 410, SEQ ID NO: 411, SEQ ID NO: 412, SEQ ID NO: 414, SEQ ID NO: 415, SEQ ID NO: 416, SEQ ID NO: 417, SEQ ID NO: 419, SEQ ID NO: 420, SEQ ID NO: 422, SEQ ID NO: 424, SEQ ID NO: 425], a biological equivalent thereof, or a fragment thereof.

47. The polypeptide of claim 45, wherein the polypeptide having 3 or more transmembrane domains comprises an amino acid sequence chosen from one of SEQ ID NO: 217, SEQ ID NO: 220, SEQ ID NO: 221, SEQ ID NO: 225, SEQ ID NO: 227, SEQ ID NO: 229, SEQ ID NO: 230, SEQ ID NO: 235, SEQ ID NO: 236, SEQ ID NO: 241, SEQ ID NO: 242, SEQ ID NO: 245, SEQ ID NO: 246, SEQ ID NO: 248, SEQ ID NO: 250, SEQ ID NO: 252, SEQ ID NO: 253, SEQ ID NO: 255, SEQ ID NO: 258, SEQ ID NO: 259, SEQ ID NO: 261, SEQ ID NO: 263, SEQ ID NO: 267, SEQ ID NO: 269, SEQ ID NO: 271,

SEQ ID NO: 274, SEQ ID NO: 280, SEQ ID NO: 286, SEQ ID NO: 290, SEQ ID NO: 291, SEQ ID NO: 292, SEQ ID NO: 295, SEQ ID NO: 297, SEQ ID NO: 299, SEQ ID NO: 302, SEQ ID NO: 303, SEQ ID NO: 305, SEQ ID NO: 308, SEQ ID NO: 309, SEQ ID NO: 313, SEQ ID NO: 314, SEQ ID NO: 316, SEQ ID NO: 317, SEQ ID NO: 318, SEQ ID NO: 322, SEQ ID NO: 323, SEQ ID NO: 327, SEQ ID NO: 329, SEQ ID NO: 330, SEQ ID NO: 332, SEQ ID NO: 333, SEQ ID NO: 334, SEQ ID NO: 335, SEQ ID NO: 339, SEQ ID NO: 344, SEQ ID NO: 345, SEQ ID NO: 348, SEQ ID NO: 350, SEQ ID NO: 354, SEQ ID NO: 355, SEQ ID NO: 360, SEQ ID NO: 361, SEQ ID NO: 366, SEQ ID NO: 367, SEQ ID NO: 368, SEQ ID NO: 369, SEQ ID NO: 372, SEQ ID NO: 374, SEQ ID NO: 375, SEQ ID NO: 378, SEQ ID NO: 379, SEQ ID NO: 381, SEQ ID NO: 382, SEQ ID NO: 383, SEQ ID NO: 384, SEQ ID NO: 388, SEQ ID NO: 390, SEQ ID NO: 392, SEQ ID NO: 393, SEQ ID NO: 395, SEQ ID NO: 396, SEQ.ID NO: 397, SEQ ID NO: 399, SEQ ID NO: 401, SEQ ID NO: 403, SEQ ID NO: 404, SEQ ID NO: 405, SEQ ID NO: 406, SEQ ID NO: 408, SEQ ID NO: 409, SEQ ID NO: 413, SEQ ID NO: 418, SEQ ID NO: 421, SEQ ID NO: 423, SEQ ID NO: 426, SEQ ID NO: 427, SEQ ID NO: 428, SEQ ID NO: 429, SEQ ID NO: 430, a biological equivalent thereof, or a fragment thereof.

48. The polypeptide of claim 45, wherein the polypeptide having an outer membrane domain or a periplasmic domain comprises an amino acid sequence chosen from one of SEQ ID NO: 218, SEQ ID NO: 223, SEQ ID NO: 224, SEQ ID NO: 238, SEQ ID NO: 254, SEQ ID NO: 265, SEQ ID NO: 277, SEQ ID NO: 282, SEQ ID NO: 293, SEQ ID NO: 300, SEQ ID NO: 340, SEQ ID NO: 349, SEQ ID NO: 362, SEQ ID NO: 380, SEQ ID NO: 387, SEQ ID NO: 394, a biological equivalent thereof, or a fragment thereof.

49. The polypeptide of claim 45, wherein the polypeptide having an inner membrane domain comprises an amino acid sequence chosen from one of SEQ ID NO: 217, SEQ ID NO: 220, SEQ ID NO: 221, SEQ ID NO: 222, SEQ ID NO: 225, SEQ ID NO: 226, SEQ ID NO: 227, SEQ ID NO: 228, SEQ ID NO: 229, SEQ ID NO: 230, SEQ ID NO: 231, SEQ ID NO: 232, SEQ ID NO:

234, SEQ ID NO: 235, SEQ ID NO: 236, SEQ ID NO: 237, SEQ ID NO: 241, SEQ ID NO: 242, SEQ ID NO: 243, SEQ ID NO: 244, SEQ ID NO: 245, SEQ ID NO: 246, SEQ ID NO: 247, SEQ ID NO: 248, SEQ ID NO: 249, SEQ ID NO: 250, SEQ ID NO: 251, SEQ ID NO: 252, SEQ ID NO: 253, SEQ ID NO: 255, SEQ ID NO: 258, SEQ ID NO: 259, SEQ ID NO: 261, SEQ ID NO: 262, SEQ ID NO: 263, SEQ ID NO: 266, SEQ ID NO: 267, SEQ ID NO: 268, SEQ ID NO: 269, SEQ ID NO: 271, SEQ ID NO: 274, SEQ ID NO: 275, SEQ ID NO: 276, SEQ ID NO: 280, SEQ ID NO: 283, SEQ ID NO: 284, SEQ ID NO: 285, SEQ ID NO: 286, SEQ ID NO: 288, SEQ ID NO: 290, SEQ ID NO: 291, SEQ ID NO: 292, SEQ ID NO: 294, SEQ ID NO: 295, SEQ ID NO: 296, SEQ ID NO: 297, SEQ ID NO: 298, SEQ ID NO: 299, SEQ ID NO: 301 SEQ ID NO: 302, SEQ ID NO: 303, SEQ ID NO: 305, SEQ ID NO: 306, SEQ ID NO: 308, SEQ ID NO: 309, SEQ ID NO: 310, SEQ ID NO: 311, SEQ ID NO: 312, SEQ ID NO: 313, SEQ ID NO: 314, SEQ ID NO: 315, SEQ ID NO: 316, SEQ ID NO: 317, SEQ ID NO: 318, SEQ ID NO: 320, SEQ ID NO: 321, SEQ ID NO: 322, SEQ ID NO: 323, SEQ ID NO: 324, SEQ ID NO: 327, SEQ ID NO: 328, SEQ ID NO: 329, SEQ ID NO: 330, SEQ ID NO: 332, SEQ ID NO: 333, SEQ ID NO: 334, SEQ ID NO: 335, SEQ ID NO: 336, SEQ ID NO: 337, SEQ ID NO: 338, SEQ ID NO: 339, SEQ ID NO: 341, SEQ ID NO: 342, SEQ ID NO: 343, SEQ ID NO: 344, SEQ ID NO: 345, SEQ ID NO: 346, SEQ ID NO: 347, SEQ ID NO: 348, SEQ ID NO: 350, SEQ ID NO: 351, SEQ ID NO: 354, SEQ ID NO: 355, SEQ ID NO: 356, SEQ ID NO: 357, SEQ ID NO: 359, SEQ ID NO: 360, SEQ ID NO: 361, SEQ ID NO: 362, SEQ ID NO: 365, SEQ ID NO: 366, SEQ ID NO: 367, SEQ ID NO: 368, SEQ ID NO: 369, SEQ ID NO: 371, SEQ ID NO: 372, SEQ ID NO: 373, SEQ ID NO: 374, SEQ ID NO: 375, SEQ ID NO: 377, SEQ ID NO: 378, SEQ ID NO: 379, SEQ ID NO: 381, SEQ ID NO: 382, SEQ ID NO: 383, SEQ ID NO: 384, SEQ ID NO: 385, SEQ ID NO: 388, SEQ ID NO: 390, SEQ ID NO: 391, SEQ ID NO: 392, SEQ ID NO: 393, SEQ ID NO: 395, SEQ ID NO: 396, SEQ ID NO: 397, SEQ ID NO: 399, SEQ ID NO: 401, SEQ ID NO: 402, SEQ ID NO: 403, SEQ ID NO: 404, SEQ ID NO: 405, SEQ ID NO: 406, SEQ ID NO: 407, SEQ ID NO: 408, SEQ ID NO: 409, SEQ ID NO: 410, SEQ ID NO: 413, SEQ ID NO: 415, SEQ ID NO: 418, SEQ ID NO: 421, SEQ ID NO: 423, SEQ ID NO: 424, SEQ ID NO: 426,

SEQ ID NO: 427, SEQ ID NO: 428, SEQ ID NO: 429, SEQ ID NO: 430, a biological equivalent thereof, or a fragment thereof.

50. The polypeptide of claim 45, wherein the polypeptide identified by Blastp analysis comprises an amino acid sequence chosen from one of SEQ ID NO: 216, SEQ ID NO: 217, SEQ ID NO: 222, SEQ ID NO: 225, SEQ ID NO: 227, SEQ ID NO: 231, SEQ ID NO: 235, SEQ ID NO: 239, SEQ ID NO: 242, SEQ ID NO: 245, SEQ ID NO: 246, SEQ ID NO: 247, SEQ ID NO: 248, SEQ ID NO: 249, SEQ ID NO: 250, SEQ ID NO: 253, SEQ ID NO: 255, SEQ ID NO: 257, SEQ ID NO: 258, SEQ ID NO: 259, SEQ ID NO: 263, SEQ ID NO: 266, SEQ ID NO: 268, SEQ ID NO: 269, SEQ ID NO: 275, SEQ ID NO: 276, SEQ ID NO: 280, SEQ ID NO: 282, SEQ ID NO: 283, SEQ ID NO: 284, SEQ ID NO: 285, SEQ ID NO: 286, SEQ ID NO: 290, SEQ ID NO: 291, SEQ ID NO: 292, SEQ ID NO: 293, SEQ ID NO: 294, SEQ ID NO: 295, SEQ ID NO: 302, SEQ ID NO: 303, SEQ ID NO: 305, SEQ ID NO: 309, SEQ ID NO: 310, SEQ ID NO: 311, SEQ ID NO: 313, SEQ ID NO: 315, SEQ ID NO: 318, SEQ ID NO: 320, SEQ ID NO: 322, SEQ ID NO: 323, SEQ ID NO: 324, SEQ ID NO: 327, SEQ ID NO: 328, SEQ ID NO: 330, SEQ ID NO: 332, SEQ ID NO: 333, SEQ ID NO: 337, SEQ ID NO: 338, SEQ ID NO: 339, SEQ ID NO: 342, SEQ ID NO: 344, SEQ ID NO: 346, SEQ ID NO: 347, SEQ ID NO: 348, SEQ ID NO: 349, SEQ ID NO: 350, SEQ ID NO: 351, SEQ ID NO: 353, SEQ ID NO: 354, SEQ ID NO: 356, SEQ ID NO: 359, SEQ ID NO: 361, SEQ ID NO: 362, SEQ ID NO: 366 , SEQ ID NO: 367, SEQ ID NO: 369, SEQ ID NO: 370, SEQ ID NO: 372, SEQ ID NO: 373, SEQ ID NO: 374, SEQ ID NO: 375, SEQ ID NO: 376, SEQ ID NO: 377, SEQ ID NO: 378, SEQ ID NO: 380, SEQ ID NO: 381, SEQ ID NO: 382, SEQ ID NO: 384, SEQ ID NO: 387, SEQ ID NO: 388, SEQ ID NO: 391, SEQ ID NO: 392, SEQ ID NO: 393, SEQ ID NO: 395, SEQ ID NO: 396, SEQ ID NO: 397, SEQ ID NO: 399, SEQ ID NO: 400, SEQ ID NO: 401, SEQ ID NO: 403, SEQ ID NO: 404, SEQ ID NO: 406, SEQ ID NO: 408, SEQ ID NO: 411, SEQ ID NO: 412, SEQ ID NO: 413, SEQ ID NO: 414, SEQ ID NO: 415, SEQ ID NO: 416, SEQ ID NO: 417, SEQ ID NO: 419, SEQ ID NO: 420, SEQ ID NO: 421, SEQ ID NO: 422, SEQ ID NO: 423, SEQ ID

NO: 425, SEQ ID NO: 427, SEQ ID NO: 428, SEQ ID NO: 429, a biological equivalent thereof, or a fragment thereof.

51. The polypeptide of claim 45, wherein the polypeptide identified by Pfam analysis comprises an amino acid sequence chosen from one of SEQ ID NO: 219, SEQ ID NO: 233, SEQ ID NO: 234, SEQ ID NO: 255, SEQ ID NO: 260, SEQ ID NO: 270, SEQ ID NO: 272, SEQ ID NO: 273, SEQ ID NO: 278, SEQ ID NO: 279, SEQ ID NO: 281, SEQ ID NO: 287, SEQ ID NO: 289, SEQ ID NO: 304, SEQ ID NO: 307, SEQ ID NO: 319, SEQ ID NO: 326, SEQ ID NO: 331, SEQ ID NO: 334, SEQ ID NO: 343, SEQ ID NO: 352, SEQ ID NO: 357, SEQ ID NO: 358, SEQ ID NO: 364, SEQ ID NO: 366, SEQ ID NO: 367, SEQ ID NO: 368, SEQ ID NO: 372, SEQ ID NO: 374, SEQ ID NO: 375, SEQ ID NO: 377, SEQ ID NO: 378, SEQ ID NO: 379, SEQ ID NO: 380, SEQ ID NO: 381, SEQ ID NO: 384, SEQ ID NO: 386, SEQ ID NO: 389, SEQ ID NO: 391, SEQ ID NO: 395, SEQ ID NO: 397, SEQ ID NO: 398, SEQ ID NO: 399, SEQ ID NO: 401, SEQ ID NO: 403, SEQ ID NO 404, SEQ ID NO: 410, SEQ ID NO: 413, SEQ ID NO 414, SEQ ID NO: 420, SEQ ID NO: 427, SEQ ID NO: 428, a biological equivalent thereof, or a fragment thereof.

52. The polypeptide of claim 45, wherein the polypeptide is a lipoprotein, the polypeptide comprises an amino acid sequence chosen from one of SEQ ID NO: 218, SEQ ID NO: 223, SEQ ID NO: 224, SEQ ID NO: 228, SEQ ID NO: 236, SEQ ID NO: 241, SEQ ID NO: 249, SEQ ID NO: 277, SEQ ID NO: 282, SEQ ID NO: 300, SEQ ID NO: 349, SEQ ID NO: 362, SEQ ID NO: 365, SEQ ID NO: 383, SEQ ID NO: 385, SEQ ID NO: 388, a biological equivalent thereof, or a fragment thereof.

53. The polypeptide of claim 45, wherein the polypeptide having a LPXTG motif and covalently associated with the peptidoglycan layer comprises an amino acid sequence chosen from one of SEQ ID NO: 228, SEQ ID NO: 236, SEQ ID NO: 249, SEQ, SEQ ID NO: 385, a biological equivalent thereof, or a fragment thereof.

54. The polypeptide of claim 45, wherein the polypeptide having a peptidoglycan binding motif and associated with the peptidoglycan layer comprises an amino acid sequence chosen from one of SEQ ID NO: 240, SEQ ID NO: 264, SEQ ID NO: 325, a biological equivalent thereof, or a fragment thereof.

55. The polypeptide of claim 45, wherein the polypeptide having a signal sequence and a C-terminal Tyrosine or Phenylalanine amino acid comprises an amino acid sequence chosen from one of SEQ ID NO:226, SEQ ID NO:254, SEQ ID NO:289, SEQ ID NO:312, SEQ ID NO:321, SEQ ID NO: 340, SEQ ID NO:402, a biological equivalent thereof, or a fragment thereof.

56. The polypeptide of claim 45, wherein the polypeptide having a tripeptide RGD sequence that potentially is involved in cell attachment comprises an amino acid sequence chosen from one of SEQ ID NO:216, SEQ ID NO:236, SEQ ID NO:281, SEQ ID NO:282, a biological equivalent thereof, or a fragment thereof.

57. The polypeptide of claim 45, wherein the polypeptide identified by proteomics as surface exposed comprises an amino acid sequence chosen from one of SEQ ID NO: 229, SEQ ID NO: 231, SEQ ID NO: 232, SEQ ID NO: 261, SEQ ID NO: 279, SEQ ID NO: 281, SEQ ID NO: 282, SEQ ID NO: 284, SEQ ID NO: 286, SEQ ID NO: 289, SEQ ID NO: 306, SEQ ID NO: 318, SEQ ID NO: 331, SEQ ID NO: 343, SEQ ID NO: 346, SEQ ID NO: 351, SEQ ID NO: 366, SEQ ID NO: 371, SEQ ID NO: 374, SEQ ID NO: 377, SEQ ID NO: 379, SEQ ID NO: 387, SEQ ID NO: 391, SEQ ID NO: 393, SEQ ID NO: 394, 395, SEQ ID NO: 397, SEQ ID NO: 420, a biological equivalent thereof, or a fragment thereof.

58. The polypeptide of claim 45, wherein the polypeptide identified by proteomics as surface exposed comprises an amino acid sequence chosen from of one of SEQ ID NO:592 through SEQ ID NO:752, a biological equivalent thereof, or a fragment thereof.

59. A recombinant expression vector comprising a nucleotide sequence having at least about 95% identity to a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591, a degenerate variant thereof, or a fragment thereof.

60. The vector of claim 59, wherein the polynucleotide is selected from the group consisting of DNA, chromosomal DNA, cDNA, RNA and antisense RNA.

61. The vector of claim 60, wherein the polynucleotide comprises heterologous nucleotide sequences.

62. The vector of claim 61, wherein the polynucleotide is operatively linked to one or more gene expression regulatory elements.

63. The vector of claim 62, wherein the polynucleotide encodes a polypeptide comprising an amino acid sequence having at least about 95% identity to an amino acid sequence chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof.

64. The vector of claim 59, wherein the vector is a plasmid.

65. A genetically engineered host cell, transfected, transformed or infected with the vector of claim 59.

66. The host cell of claim 65, wherein the host cell is a bacterial cell.

67. The host cell of claim 66, wherein the polynucleotide is expressed to produce the encoded polypeptide, a biological equivalent thereof, or a fragment thereof.

68. An antibody specific for a *Streptococcus pneumoniae* polynucleotide chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431

through SEQ ID NO: 591, a fragment thereof, a degenerate variant thereof, or a *Streptococcus pneumoniae* polypeptide chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof.

69. The antibody of claim 68, wherein the antibody is selected from the group consisting of monoclonal, polyclonal, chimeric, humanized and single chain.

70. The antibody of claim 69, wherein the antibody is monoclonal.

71. The antibody of claim 70, wherein the antibody is humanized.

72. An immunogenic composition comprising a polypeptide having an amino acid sequence chosen from one or more of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof.

73. The immunogenic composition of claim 72, further comprising a pharmaceutically acceptable carrier.

74. The immunogenic composition of claim 72, further comprising one or more adjuvants.

75. The immunogenic composition of claim 72, wherein the polypeptide is further defined as:

(a) a *Streptococcus pneumoniae* polypeptide having 0, 1 or 2 transmembrane domains;

(b) a *Streptococcus pneumoniae* polypeptide having 3 or more transmembrane domains;

(c) a *Streptococcus pneumoniae* polypeptide having an outer membrane domain or a periplasmic domain;

(d) a *Streptococcus pneumoniae* polypeptide having an inner membrane domain;

(e) a *Streptococcus pneumoniae* polypeptide identified by Blastp analysis;
(f) a *Streptococcus pneumoniae* polypeptide identified by Pfam analysis;
(g) a *Streptococcus pneumoniae* lipoprotein;
(h) a *Streptococcus pneumoniae* polypeptide having a LPXTG motif, wherein the polypeptide is covalently attached to the peptidoglycan layer;
(i) a *Streptococcus pneumoniae* polypeptide having a peptidoglycan binding motif, wherein the polypeptide is associated with the peptidoglycan layer;
(j) a *Streptococcus pneumoniae* polypeptide having a signal sequence and a C-terminal Tyrosine or a C-terminal Phenylalanine amino acid;
(k) a *Streptococcus pneumoniae* polypeptide having a tripeptide RGD amino acid sequence;
(l) a *Streptococcus pneumoniae* polypeptide identified by proteomics as surface exposed;

and

(m) a *Streptococcus pneumoniae* polypeptide identified by proteomics as membrane associated.

76. The immunogenic composition of claim 75, wherein the polypeptide further comprises heterologous amino acids.

77. The immunogenic composition of claim 75, wherein the polypeptide is a fusion polypeptide.

78. The immunogenic composition of claim 75, wherein the polypeptide is encoded by a polynucleotide comprising a nucleotide sequence having at least about 95% identity to a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591, a degenerate variant thereof, or a fragment thereof.

79. The immunogenic composition of claim 78, wherein the polynucleotide further comprises heterologous nucleotides.

80. An immunogenic composition comprising a polynucleotide having a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591, a degenerate variant thereof, or a fragment thereof and is comprised in an expression vector.

81. The immunogenic composition of claim 80, wherein the vector is plasmid DNA.

82. The immunogenic composition of claim 81, wherein the polynucleotide comprises heterologous nucleotides.

83. The immunogenic composition of claim 82, wherein the polynucleotide is operatively linked to one or more gene expression regulatory elements.

84. The immunogenic composition of claim 83, wherein the polynucleotide directs the expression of a neutralizing epitope of *Streptococcus pneumoniae*.

85. The immunogenic composition of claim 84, further comprising one or more adjuvants.

86. A pharmaceutical composition comprising a polypeptide and a pharmaceutically acceptable carrier, wherein the polypeptide comprises an amino acid chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof.

87. The pharmaceutical composition of claim 86, wherein the polypeptide is further defined as:
    (a) a *Streptococcus pneumoniae* polypeptide having 0, 1 or 2 transmembrane domains;
    (b) a *Streptococcus pneumoniae* polypeptide having 3 or more transmembrane domains;

(c) a *Streptococcus pneumoniae* polypeptide having an outer membrane domain or a periplasmic domain;

(d) a *Streptococcus pneumoniae* polypeptide having an inner membrane domain;

(e) a *Streptococcus pneumoniae* polypeptide identified by Blastp analysis;

(f) a *Streptococcus pneumoniae* polypeptide identified by Pfam analysis;

(g) a *Streptococcus pneumoniae* lipoprotein;

(h) a *Streptococcus pneumoniae* polypeptide having a LPXTG motif, wherein the polypeptide is covalently attached to the peptidoglycan layer;

(i) a *Streptococcus pneumoniae* polypeptide having a peptidoglycan binding motif, wherein the polypeptide is associated with the peptidoglycan layer;

(j) a *Streptococcus pneumoniae* polypeptide having a signal sequence and a C-terminal Tyrosine or a C-terminal Phenylalanine amino acid;

(k) a *Streptococcus pneumoniae* polypeptide having a tripeptide RGD amino acid sequence;

(l) a *Streptococcus pneumoniae* polypeptide identified by proteomics as surface exposed;

and

(m) a *Streptococcus pneumoniae* polypeptide identified by proteomics as membrane associated.

88. The pharmaceutical composition of claim 87, wherein the polypeptide further comprises heterologous amino acids.

89. The pharmaceutical composition of claim 87, wherein the polypeptide is a fusion polypeptide.

90. A DNA chip comprising an array of polynucleotides, wherein at least one of the polynucleotides comprise a nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591, a complement thereof, a degenerate variant thereof, or a fragment thereof.

91. A protein chip comprising an array of polypeptides, wherein at least one of the polypeptides comprises an amino acid sequence chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof.

92. A method of immunizing against *Streptococcus pneumoniae* comprising administering to a host an immunizing amount of an immunogenic composition comprising a polypeptide and a pharmaceutically acceptable carrier, wherein the polypeptide comprises an amino acid sequence chosen from one or more of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof.

93. The method of claim 92, wherein the polypeptide is a fusion polypeptide.

94. The method of claim 92, further comprising an adjuvant.

95. A method for the detection and/or identification of *Streptococcus pneumoniae* in a biological sample comprising:
   (a) contacting the sample with an oligonucleotide probe of a polynucleotide comprising the nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591, a degenerate variant thereof, or a fragment thereof, under conditions permitting hybridization; and
   (b) detecting the presence of hybridization complexes in the sample, wherein hybridization complexes indicate the presence of *Streptococcus pneumoniae* in the sample.

96. A method for the detection and/or identification of *Streptococcus pneumoniae* in a biological sample comprising:
   (a) contacting the sample with an oligonucleotide primer of a polynucleotide comprising the nucleotide sequence chosen from one

of SEQ ID NO: 1 through SEQ ID NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591, a degenerate variant thereof, or a fragment thereof, in the presence of nucleotides and a polymerase enzyme under conditions permitting primer extension; and

(b) detecting the presence of primer extension products in the sample, wherein extension products indicate the presence of *Streptococcus pneumoniae* in the sample.

97. A method for the detection and/or identification of *Streptococcus pneumoniae* in a biological sample comprising:

(a) contacting the sample with an antibody specific for a polypeptide comprising an amino acid sequence chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof, under conditions permitting immune complex formation; and

(b) detecting the presence of immune complexes in the sample, wherein immune complexes indicate the presence of *Streptococcus pneumoniae* in the sample.

98. A method for the detection and/or identification of antibodies to *Streptococcus pneumoniae* in a biological sample comprising:

(a) contacting the sample with a polypeptide comprising an amino acid sequence chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof, under conditions permitting immune complex formation; and

(b) detecting the presence of immune complexes in the sample, wherein immune complexes indicate the presence of *Streptococcus pneumoniae* in the sample.

99. A kit comprising a container containing an isolated polynucleotide comprising an nucleotide sequence chosen from one of SEQ ID NO: 1 through SEQ ID

NO: 215 or SEQ ID NO: 431 through SEQ ID NO: 591, a degenerate variant thereof, or a fragment thereof.

100. The kit of claim 99, wherein the polynucleotide is a primer or a probe.

101. The kit of claim 100, wherein the polynucleotide is a primer and the kit further comprises a container containing a polymerase.

102. The kit of claim 99, wherein the kit further comprises a container containing dNTP.

103. A kit comprising a container containing an antibody that immunospecifically binds to a polypeptide comprising the amino acid sequence chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof.

104. A kit comprising a container containing an antibody that immunospecifically binds to a fusion polypeptide comprising at least the amino acid sequence chosen from one of SEQ ID NO: 216 through SEQ ID NO: 430 or SEQ ID NO: 592 through SEQ ID NO: 752, a biological equivalent thereof, or a fragment thereof.

105. A method for producing a polypeptide which comprises culturing the genetically engineered host cell of claim 66 under conditions suitable to produce the polypeptide and recovering the polypeptide from the culture.

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<212> DNA
<213> Streptococcus pneumoniae

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<212> DNA
<213> Streptococcus pneumoniae

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<211> 1251
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<213> Streptococcus pneumoniae

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<211> 1245

<212> DNA
<213> Streptococcus pneumoniae

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<211> 5310
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<213> Streptococcus pneumoniae

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<211> 294
<212> DNA
<213> Streptococcus pneumoniae

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<211> 915
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<213> Streptococcus pneumoniae

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<213> Streptococcus pneumoniae

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<212> DNA
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<213> Streptococcus pneumoniae

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<212> DNA
<213> Streptococcus pneumoniae

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ccaagtgaag gtaaggttta tgcaccattt gatgggaaaa ttacaaatat ttttccgact 1560

aagcacgcaa ttggattgaa gagtgatgag ggtgttgagt tactaattca tattggatta 1620

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ttcaaaaatc agttgatttt tgaaatggac ttgaatttaa tcaagactaa aggctacgaa 1740

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<210> 39
<211> 246
<212> DNA
<213> Streptococcus pneumoniae

<400> 39
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ggagccaact cctgcatatc ctgcaaggct gaaataatgt tatcattacc cacggctggg 180

tttggaggga acacttcaaa tgagagtgac ggtgtttggc gtgacatatg taataacctt 240

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<210> 40
<211> 669
<212> DNA
<213> Streptococcus pneumoniae

<400> 40
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gccttggctg agattattcg aggcggtctc aatgccgtag acaagggaca gtacgaagca 360

ggaatgtcac aaggcttcac ctcagcccaa atcctctact acatcattct cccacaagcc 420

atccgcaaaa tgctaccagc catcatttct cagtttgtta ccgtgattaa ggataccagt 480

ctcctctact ctgttatcgc cctacaagaa ctctttggag ccagccaaat tctcatgggc 540

cgttatttcg aaccagagca ggtcttcagt ctttacatcc tgattgccct catctacttc 600

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gcagaataa 669

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<211> 768
<212> DNA
<213> Streptococcus pneumoniae

<400> 41
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tctggctctg ggaagtccac tcttatccgt acgatcaatg gtttagagac tgttgacaaa 180

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gccatgctat ctggtggaca aaaacagcgg atcgccatcg ctcgtggtct tgctatgcat 480

ccggaactcc tcctctttga tgaaccaaca tctgctcttg atcctgagac tatcggagat 540

gttctagcag ttatgcagaa actggcgcat gatgggatga acatgatcat cgttacccac 600

gaaatgggct ttgctcgaga ggttgcggac cgcattatct ttatggccga cggagaagtt 660

ttagtagata cgacagatgt cgataacttt tttgacaatc caagcgaacc tcgtgcccaa 720

caattcctca gcaaaattat caaccacgaa agtgacaaag tcaaataa 768

<210> 42
<211> 1224
<212> DNA
<213> Streptococcus pneumoniae

<400> 42
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catgagaagt ttggtgttta cagggaagaa aaattactgg cgacagctag tattttgatt 180

agaactcttc cgctaggcta taaaatgttt tacatcccaa gaggacctat attggattat 240

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acagcacgaa acaaagggct tgagattcaa tatggtggac tggaactatt agattcattt 600

tcggagttga tgaaaaaaac tgagaagcga aaagagattc atttgaggaa tgaagcctat 660

tataaaaaat tgttagataa ttttaaggac aaggcctata tcaccttggc caccttggat 720

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acaatgccca ctcatcctct ctatcctctg ttaagacttg ctcttgattt ccgtaaaaca 1200

ttaagaaaaa aacatagaaa gtaa 1224

<210> 43
<211> 636
<212> DNA
<213> Streptococcus pneumoniae

<400> 43
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gcggggaact tgatttttcc gccttctcta ggtgctctat ctggagaaca ttttcttcct 180

gccatcgcag gttttgtctt ttcaggcgtt ggtatcgccg tcttgaccct tattattgga 240

acgctaaatc ctaaaggata tatctacgag atttcaacga agatagcgcc ttggtttgcg 300

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gctacaacag cttacgaagt agggattagc ccccttttgt cggatgcaaa taaaggactt 420

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tcaaaaatct tagaccgcat tggacgtatt ttaacgccag tctttgcaat tttgattgtt 540

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<210> 44
<211> 2049
<212> DNA
<213> Streptococcus pneumoniae

<400> 44
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gcgatgaagg gtggaacacc aggtgtttac atcttgtcac aagccactca agaaatcttt 420

ggctcaacag ctcaactctt ccttgcagct atggttaccg taacctgctt cacaacgact 480

gttggtttga ttgtgtcaac agctgagttc tttaatgagc gcttcccaca aatcagctac 540

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gcgattatca agtactcaat tccagtactg gttatcttgt acccaatcac gattgctatc 660

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aagctggata tctatccatt ttatggttcg gacgcttcag cggctatgtc tgcaggggca 1920

gaagtcaaac acgcccttct cggtgctggt atagagtcta gccattccta tgagcgtacc 1980

catattgact cggtgatcgc aacagaacga atggtcgatg cttatcttaa gagcacgttg 2040

gtggactaa 2049

<210> 45
<211> 1032
<212> DNA
<213> Streptococcus pneumoniae

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catcttcaga aaaattttgt gaagactgtt aaggaaccgg gcttgaaggg ggctttgcgc 120

tcctttattc atcctgaaaa gcagaccttt gaagcggtca aggatttgac ctttgaggtt 180

ccaaaagggc agattttagg atttatcggg gcaaatggtg ctgggaagtc gacaaccatt 240

aaaatgctga caggaatttt gaaaccaaca tctggttttt gtcggattaa cggcaagatt 300

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cagctatggt gggatttggc tctgcaagag acctacactg tcttaaaaga gatttatgat 420

gtgccagact cgctctttca taagcgtatg gactttttga atgaagtctt ggatttgaag 480

gactttatca aggatcccgt gcggactctt tcactgggac aacggatgcg ggcggatatt 540

gcggcctcct tgctccacaa tcccaaggtt cttttttag atgagccgac cattggtttg 600

gacgtttcgg ttaaggataa tattcgtcgg gcaattactc agatcaatca agaggaagaa 660

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atccgcgatt tgaagatggt ggatacggat attgaggata ttatccgtcg cttctaccga 1020

aaggagctct ag 1032

<210> 46
<211> 1509
<212> DNA
<213> Streptococcus pneumoniae

<400> 46
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aaggttttca atcccatctt agaaatgggt ggacctgtca tcatgttaat cattttgaca 120

gtattggctt tactttttgg agtgaaattc tccaaagcgc ttgaaggtgg tatcaaactt 180

gccatcgctc ttacaggtat cggtgctatc atcggtatgc taaacactgc tttctcagca 240

tcactagcaa aattcgttga aaacactggt atccaattga gtattaccga cgttggttgg 300

gcaccacttg ctacaatcac ttggggttct gcttggacac tatacttctt gctcatcatg 360

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ggtgtgagtc aaggggtttc actctttatt gctacagcag ctatcgtcct tgtcggtgtg 540

ttgaaaatta tcaactctga cttgatgaaa cctacatttg atgaccttct taacgcccca 600

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ttggataaga tttttgaaaa attcttccca ggccttgata aatatgactt tgatgctgct 720

aaattgaaca agaaaatcgg tttctgggga tctaaattct tcatcggttt catccttggt 780

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attactcact ctactcttga aggaccaatc gaaaaacttc ttggttggac aattggtaac 1380

actacaactg gtgatatcaa agcaatcctt ggtgcagtag tcttccttgt attctatatc 1440

ggtatctttg cttggtacag aaaacaaatg atcaaacgta acgaagagta cgcagcaaaa 1500

gcaaaataa 1509

<210> 47
<211> 366
<212> DNA
<213> Streptococcus pneumoniae

<400> 47
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gtcgtctgca ttatcctaac caaacttttt agattaaaaa aactaggacg aaactttgcg 120

gatttggctt ttccagtctt ggtatttgag tattacttga ttacagctaa aacctttacc 180

cataatttcc tccctagact ggggctagcc ctctcgatcc tagccattat tctcgtcttt 240

ttcttccttt tgaaaaaacg cagcttttac taccctaaat ttatcaaatt cttctggcgt 300

gcaggattct tattaaccct tatcatgtat atagaaatga ttgttgaatt gttcttaatg 360

aaatag 366

<210> 48
<211> 729
<212> DNA
<213> Streptococcus pneumoniae

<400> 48
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attctatcct tcttttctcc ttgtatctta cctttgttac cggtctatac aggagtgtta 120

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tttgaataa 729

<210> 49
<211> 303
<212> DNA
<213> Streptococcus pneumoniae

<400> 49
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agcatgagcc ttgataaatt caacctcaac tggatcctgc ataaacttaa aggctgccaa 180

ctgccccgaa cctcctgcat gaagagtagg atggacactg acaatttcca gaccaaactg 240

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taa 303

<210> 50
<211> 1014
<212> DNA
<213> Streptococcus pneumoniae

<400> 50
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attttagcct tgttttcaca atcagttttg gcggaagaaa acatccattt ttcgagctgt 120

aaggaagctt gggcgaatgg ctattcggat attcacgagg gagaacctgg ttattctgcc 180

aagttagacc gtgatcatga tggtgtggct tgcgaattga aaaatgctcc taagggtgct 240

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tataattcgt tattccacat gtcaaaaaaa cgtatgtata gacaattaac ttctgatttt 960

gataaatttt caaatgatgc agctcaatat gccattgatc atttagatga ttaa 1014

<210> 51
<211> 1239
<212> DNA
<213> Streptococcus pneumoniae

<400> 51
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atggacagtt ttgacctctc catggaagaa ttggctagtt tagcgaaaac ggcaggggca 120

gtcgttgtag atagctacag acaaaaacgt gaaaaatatg attccaagac cttcgtcggc 180

tctggtaagt tggaagagat tgcgcttatg gtggatgcag aagaaatcac tactgtcatc 240

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gcatttaccc tgcgagtgcc tttttcaaag tcctacaaga ttcatgattt agagagtgtt 1140

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<210> 52
<211> 267
<212> DNA
<213> Streptococcus pneumoniae

<400> 52
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gcactcttga ttttattggt tctatctttt ctgaaaattt ttcaattacc aacagaaata 180

ttcctagcaa tagccatgtt gatcctagct tactttagtg ttagagacat cacactcatg 240

ccagtcaaaa aaagtaaaag aagataa 267

<210> 53
<211> 810
<212> DNA
<213> Streptococcus pneumoniae

<400> 53
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actaaaggtt actattcgtt attttataat gaagagtata ataaaataca gaataaaaca 120

gtattagtat taggagcagg agtcttagga tgttatatat ctctaagtct aagtatgtat 180

ggagtgagga aacttattgt cgctgattac gatataatag aaccatcaaa tttaaatagg 240

caaattcttt atacagagtc ggatgttggt aaggagaaga ttaatgttct ttctgaaaaa 300

atacacaagt ataattcaga tgttcaggta gtacctattt ctattaaagt ttcttcagta 360

gaagaattag aaaaaattgt tgcggaatat gggagtatag attttatcgt taaagcaatt 420

gatacgccca ttgatattat aaaaattgtc aatcaatttg ctgtatcgca taagatatcc 480

tacatatcag gagggtttaa tggatgctat cttattattg ataatatata tatccctacc 540

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gataagacaa agtggccgac tacaccagag atgcctgcta ttttgggagg gataatgact 660

aatttaataa ttaaaatatt tctgggatgt tataatgaaa tcctaataga taacgcttac 720

gtttataata tgagaaatca tgctctaagt caagaaaaat atgttctgga aaacggagaa 780

tgtccaattt gtaaaaaaat aataaagtga 810

<210> 54
<211> 393
<212> DNA
<213> Streptococcus pneumoniae

<400> 54
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gaaacacaat taatagtatt gttcttgggt attatttttg ctatatatta tgcttactac 180

aataaaaata ttcaaacatc attggaaaat atagtatggc ttttttcatc gtttgagatt 240

ttatttttgc ttgttaattt tagaacattt attcagttac cagtggatat ttttattggt 300

atgataatat ttttaatgct gtggatattt attatgttag gtatagtgtg tcttagttat 360

tatataactt tattatttag caaggaggct tag 393

<210> 55
<211> 750
<212> DNA
<213> Streptococcus pneumoniae

<400> 55
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acaagcggtg aattaaagag aattggattg gttagcgata caagtggatt ttatgagaaa 180

atgtctctgt ataacaatct tctttttttat agtaaatttt ataatattag taaatcacgt 240

gttgataatt tgttaaagcg agtaggatta tatgatagtc gcaagatggt agcaggaaaa 300

ttatccactg gaatgaggca acgaatgctt ttagcacgag ctcttatcaa caaccccgct 360

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gagttaattt tagaattgaa aacagcaggg acaacgattt ttctaacgac tcatgatatg 480

aatgaagcaa ctcttttatg tgattatgtt gccttattaa ataaagggaa attagttgag 540

caaggagctc cttctgaact cattcaaaga tataataaag ataaaaagat taaggttaca 600

gattataatg ggaatcagat aacttttgat tttacatcac tagaacaggt atctcagact 660

gatctggaaa atattttttc aattcattca tgtgagccta ctttagaaga tatttttatc 720

acattaacag gaggaaagct aaatgcttaa 750

<210> 56
<211> 777
<212> DNA
<213> Streptococcus pneumoniae

<400> 56
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ttttatatgt ctttattttt gacccttctt tgcatgagtt taggaaattt ccttgctttc 120

aatggtattt ataaaattga aggtttatcg attttttttg ccgcttcttc tattcgagga 180

ttttcaccga ttagcctagt agctgcactt atctgtacac tgccctattc tagtcagata 240

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ggtatttttt gggctatttt agggctatct tacttagaac ctgtgacaac gctagctttg 660

ggatatcaga aagatatcag tctttcctta gttagtgctc atcttgcttt tattttattt 720

gttagttgtt tggttgttta tggtacattt tttctacatt cagaggacta tgtataa 777

<210> 57
<211> 777
<212> DNA

<213> Streptococcus pneumoniae

<400> 57
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gttgctattt ttagtctttc tttttcaaag cattttctat ttcactcgtc aaaagaggag 120

gtttatagaa tgaatgaaat aattacatta aaaaatattg agttgaaatt aaaaaagaca 180

tgtgtttttc aaaaccttaa ctttagttgt aaacaggggg aaattatagg aattactggt 240

gcgaatggct cagggaaaag tgtattgttt aaattaatag ctggtttata tagtccgtct 300

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caatatttgg caagcatacg aggagtagtt ggtaatcagg aaatcaatga tacactgaaa 480

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cctatgaatg ccttggataa atcaagtgta gaaaatatga gaacattgtt tagaaagctc 660

tctagtgaaa aagggacaac aattttgatt gctagtcata gtgaagagga tattcgtatc 720

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<210> 58
<211> 759
<212> DNA
<213> Streptococcus pneumoniae

<400> 58
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ctccaaggac tttctctaga aatcaaaaaa ggggaagttg ttgtcatcct agggccatct 120

ggttgtggga aaagtaccct ccttcgttgc ctcaacggct tagaaagtat tcaaggtgga 180

gatattcttc tggatggtca gtctatcgtt gaaaataaaa aagattttca cctagttcgc 240

caaaagattg gcatggtctt tcaaagttat gaactctttc cccatctgga tgtcttacaa 300

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ttatctggtg gacagaagca acgtgttgca attgtccgtg ccctcctaat gcatccagaa 480

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cagtttgccc aagccattac tgaccggatt atcttcctcg accaagggaa aatcgctgaa 660

gaaggaacag ctcaagcctt ctttaccaat ccgcaaacca aacgagccca ggaattttta 720

aacgtctttg actttagcca attcggctca tatctataa 759

<210> 59
<211> 672
<212> DNA
<213> Streptococcus pneumoniae

<400> 59
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tatcgaatcc ttgttttggc gcaagtagcg acagcctaca ttgaattgtc acgtaatacg 180

cccttttga ttcaactctt ctttctctac ttcggtcttc cccgaatcgg gattgtccta 240

tcttcagaag tctgtgcaac gcttgggctt gtctttttag gaggctccta tatggcagaa 300

tctttccgaa gtgggctgga agccatcagt caaacccagc aggagattgg cctcgctatt 360

ggtctgacac ctctacaggt cttttactat gtggttcttc cgcaagcaac agcggtggca 420

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gacattgcgc tagctatgtt ggtagttgct tatctaatca tgctgctacc catctcactg 600

gtctttagct ggatagaaag gaggctccgc catgcaggat tcgggaatcc aagtactctt 660

tcaaggaaat aa 672

<210> 60
<211> 1386
<212> DNA
<213> Streptococcus pneumoniae

<400> 60
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tttcatgcgc aagcctttac cttgttagtt gggagtagtg ggtctggaaa atccagcctc 120

tttcaaatga ttgcccaagt tagttctctt ccctatagcg gtcaagtcct gatagatggg 180

agcgaggtca gtcagctttc tatcgtcgaa cgtgtccaga cggttggtat tctcttgcaa 240

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agatag 1386

<210> 61
<211> 1212
<212> DNA
<213> Streptococcus pneumoniae

<400> 61
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acagaaaatg gtgttaaact taaggtcgaa gaccacggac gcgtctttcc agccagtgac 360

aagtctcgga ctattatcga agctttggaa aagaaaatca ccgaactagg tggtcaagtt 420

gctactcaaa tagaaatcgt ttctgttaaa aaagtagatg accagtttgt ccttaagtca 480

gcggatcaaa ccttcacttg tgagaaactc attgtcacaa caggtggtaa gtcttatcct 540

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cttgaaagta agctggtacc tggcctccac tttgcaggcg aagttatgga tatcaatgcc 1140

cacacgggtg gctttaacat cacttctgcc ctctgtaccg gctgggtggc gggaagtctg 1200

cattatgatt aa 1212

<210> 62
<211> 264
<212> DNA
<213> Streptococcus pneumoniae

<400> 62
ggagacaaaa agatgaagaa aaaatttgcc ctatcgtttg tggcgcttgc aagtgtagca 60

cttcttgcag cctgtggaga agtgaagtct ggagcagtca acactgctgg taactcagta 120

gaggaaaaga caattaaaat cgggtttaac tttgaagaat caggttcttt agctgcatac 180

ggaacagctg aacaaaaagg tgcccaattg gctgttgatg aaatcaatgc cgcagtggta 240

tcgatggaaa acaaatcgaa gtag 264

<210> 63
<211> 783
<212> DNA
<213> Streptococcus pneumoniae

<400> 63
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ggtctaacag ctgttggaga tgtgactctt gaattgaacg aaggggaact ggttggatta 120

atcggtccaa acggagctgg gaaaaccacc cttttcaacc ttttgaccgg tgtttatgaa 180

ccaagcgagg gaacagtaac cctagatggt caccttttga atgggaaatc accttataag 240

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ggacaacaac gtcgtttgga aattgttcgt gcccttgcta cggaacctaa aattctcttc 540

ttagatgaac cagcagcagg tatgaaccca caggaaacag ccgaattgac tgagttaatt 600

cgtcgtatca aagatgagtt taagattaca atcatgttga ttgaacacga tatgaatctg 660

gtcatggaag taacagaacg tatctacgta cttgaatatg gccgtttaat cgctcaagga 720

actccagacg aaattaagac caataaacgc gttatcgaag cttatctagg aggtgaagcc 780

taa 783

<210> 64
<211> 705
<212> DNA
<213> Streptococcus pneumoniae

<400> 64
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ggaccttcag gagcagggaa gtcaactttt attcgttctc tgtatcgtga agtaaaaatc 180

gataaaggaa gcctatcagt tgctggtttt aatctggtta agatcaaaaa gaaagatgtc 240

ccgcttctac gtcgtagtgt tggggttgtc ttccaggatt ataaattgtt accaaagaaa 300

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aaaagacgag tgatggaagt tttggacttg gttggattga agcataaggt tcgttctttc 420

ccaaatgaac tctcaggtgg ggagcaacag cggattgcga ttgcgcgtgc aattgtaaat 480

aatcccaaag tattgatagc tgatgagcca acaggaaatc tggatccgga taattcatgg 540

gaaattatga atctcttgga acggattaac ctacaaggaa caactatttt gatggcgact 600

cataatagcc agattgtaaa taccttgcgc caccgtgtca ttgccattga aaatggccgt 660

gtcgttcgtg acgaatcaaa aggagagtat ggatacgatg attag 705

<210> 65
<211> 2181
<212> DNA
<213> Streptococcus pneumoniae

<400> 65
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gctttgatgg tagttatcgc ggttatgccg gctgctggtt tgatgatttc aatcggtaag 120

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<210> 66
<211> 1551
<212> DNA
<213> Streptococcus pneumoniae

<400> 66
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<210> 67
<211> 822
<212> DNA
<213> Streptococcus pneumoniae

<400> 67
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cttgctgctg aagaaagttc caaagtagct gcccaatctg ccaaggagtt aaacgatgct 180
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aacgagatta ctccttattt gtataacatc cgtggtgctc ttgctatggc taatactggt 540

caaccaaaca ccaatggcag ccagttcttc atcaaccaaa actctacaga tacctcttct 600

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cctagtctag atggcaaaca cccagtcttt ggtcaagtga ttgacggtat ggatgttgtg 720

gataagattg ctaaggccga aaaagatgaa aaagacaagc caactactgc tatcacaatc 780

gacagcatcg aagtggtgaa agactacgat tttaaatctt aa 822

<210> 68
<211> 1368
<212> DNA
<213> Streptococcus pneumoniae

<400> 68
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gaaaagaaat taggtggaac ctgtgtcaac gtcggttgtg ttcctaaaaa aatcatgtgg 180

tacggggcgc aaatcgctga gactttccat caatttggag aagactacgg ctttaagact 240

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ggctcttctg atgatgtatt tgcctgggaa gaacttccag agtcaattgc cattctaggc 540

gctggttata tcgccgttga attagctggc gtactccaca cttttggtgt caagacagat 600

ctctttgttc gccgcgatcg tcctttacgt ggttttgatt cctacatcgt tgaaggtttg 660

gtcaaggaaa tggaaagaac aaacttacca cttcacactc acaaagtccc tgtcaagtta 720

gaaaaaacta ctgacggcat taccattcat ttcgaagatg gtactagtca cacagctagc 780

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gagggaatct atgctctagg tgatgtaacg ggcgagaaag aactgactcc agttgcaatc 960

aaggccggac gtaccctatc tgaacgtctc tttaacggaa aaactactgc aaaaatggat 1020

tactcaacta ttccaactgt tgtcttttca caccctgcta tcggaactgt tggtttgaca 1080

gaagagcaag ctattaaaga atacggtcaa gaccaaatca aggtttataa atcaagcttt 1140

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gctggttcag aagaaaaagt tgtcggactt catggaattg gctacggcgt tgatgaaatg 1260

attcagggat ttgccgttgc tatcaaaatg ggagcaacca aggctgactt tgatgcaact 1320

gtggcaattc acccaactgc atctgaagaa tttgtaacca tgcgttaa 1368

<210> 69
<211> 1338
<212> DNA
<213> Streptococcus pneumoniae

<400> 69
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cattcgagtc tttatacttc ggtggacgat aagcttcatg gactgagtga aaatcctcaa 180

gcagttattc agctggctat aaatagggca acagaagaga ttaaagattt agaaaatgct 240

agggcggacg ctagtaaagt agaaataaaa cctaatgtca gttccaatac ggaagtcatt 300

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gggcaggaag aaatctatcg tgtgattttg atggagacca atattagttc ggtttcaacc 480

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gatcgcaatc tttatttact tgtttctgat aatggaatcg gtatttcgac agaagataaa 1140

aagaaaattt ttgaccgttt ttatcgagta gacaaggcta gaacccggca aaaaggtggt 1200

tttggtttag gattatccct agccaagcaa attgtagatg ctctaaaagg aactgttact 1260

gtcaaagata ataaacccaa gggaacaatc tttgaagtga agattgccat tcagacacca 1320

tctaaaaaga aaaaataa 1338

<210> 70
<211> 1092
<212> DNA
<213> Streptococcus pneumoniae

<400> 70
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aaagcatggc tgattttgga gaaatgtggt ataatttttc ttatggaaaa gattgtcatt 180

acagcaactg ctgaaagtat tgaacaagtt gaacaactac tcgaagctgg cgtagaccgt 240

atctatgtcg gtgagaaaga ttttggtctt cgtctgccaa cgacctttag ttatgaccaa 300

ttacgtgaaa tcgctaagtt ggttcatgat gctggtaagg aattgatcgt tgcggtcaat 360

gctctcatgc accaagatat gatggaccgt atcaagcctt tcttaaactt cttggaagaa 420

atcaagacag actatattac gattggggat gcaggcgtct tttacgtagt taaccgcgat 480

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gctgaacttt tcaaaatgcc agagattttg gaaattcctg ctgaagtttt ggtttacggt 660

gctagcgtca tccatcattc taaacgtcca ctcttgcaaa actactataa ctttacacat 720

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agccactatt ccatttttga agataatcat gggacccata tctttgccaa caatgacctt 840

gatttgatga tcaaattaac agaattggtg gagcatggct ttactcgctg gaaactagaa 900

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cgtaaacttc accctaaaaa ccgtttcctt gatacaggat tttatgacta cgatcctgac 1080

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<210> 71
<211> 765
<212> DNA
<213> Streptococcus pneumoniae

<400> 71
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aactatgggg ctgttgtgac gattcttatt tctatctgtg ttatcttttt gggaactatt 180

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gctcttatgc atatcaatgc tccgactatt cagattggaa ttttaggtgt tgatttttcg 360

cgtctgattc cagggatttt gattatctct atgaatagtg gtgcttatgt ttcggagact 420

gttcgtgccg gaatcaatgc ggttccaaaa ggtcagctag aagcggctta ttcgctaggg 480

attcgtccta aaaatgcgat gcgttatgtg attttgccac aagcagtcaa aaatatcttg 540

ccagcattgg ggaacgaatt tatcaccatt atcaaggaca gctccctctt atcagctatt 600

ggggtcatgg agttgtggaa tggggctaca acagtttcta caacaaccta tctaccttta 660

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ttgaaagctt ttgaaaaaca tatgggacaa ggagataaga aataa 765

<210> 72
<211> 741
<212> DNA
<213> Streptococcus pneumoniae

<400> 72
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atgcgtgaga agatgggcat ggtttttcaa caattcaatc tctttcctaa tatgactgtg 300

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gttctggctg ttatgcaaga tctagccaag tcaggaatga ccatggttat cgtaacacat 600

gagatgggat ttgcccgtga ggtggcagat cgtgtcatct ttatggcaga cggtgtggtt 660

gttgaagacg gaacacctga gcagattttt gaacaaaccc aaggacaaag gactaaagac 720

ttcttgagta aggttttata a 741

<210> 73
<211> 261
<212> DNA
<213> Streptococcus pneumoniae

<400> 73
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tttatttgtt cgttcttaat tgctttctta ctaaaaaacg atggacgaaa tggattgctg 240

cgggtagtta ttgcttttta g 261

<210> 74
<211> 1548
<212> DNA
<213> Streptococcus pneumoniae

<400> 74
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gaaccaacta gtggtgaaat cgcggtcaac ggtcaagttg tcaatctcga ctccccatct 240

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acagtggctg aaaacatcat tttaggtagt gaattgacta aaaatggtgt gctagatatc 360

gctggagcta gcaaagaaat caaggctctt tctgaacgtt atggcttagc tgttgaccct 420

tctgccaagg tagcagatat ctcagttgga gcccaacaac gtgtagaaat tttaaaaaca 480

ctttatcggg ggctgatat ccttatcttt gacgaaccaa cggctgtttt gactccatca 540

gaaattgatg agttgatggc tattatgaaa aatcttgtca aagaaggaaa atcaattatc 600

ttgattaccc acaaattgga tgaaattcga gcagtttctg accgtgttac agttatccgt 660

cgtgggaaat caattgaaac cgttgaaatt gcaggggcta ccaatgctga tttggcggaa 720

atgatggtag gacgttctgt ttcctttaaa acagagaagc aagcctctaa accaaaagaa 780

gtggttttgt ctatcaaaga tttggtggtc aatgaaaacc gtggtgttcc agctgttaaa 840

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tcaaatatta cttcttatgc taaaaagctg atggaagagt ttgatgttcg cgctgccagt 1200

gaattagttc ctgcagctgc actctcagga ggaaatcaac aaaaagcaat tattgctcgt 1260

gaaattgatc gagatcctga tctccttatc gttagccagc caactcgtgg gttggatgtc 1320

ggtgccattg agtatatcca caaacgcttg attgaagagc gtgataatgg caaggctgtc 1380

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gtcttgatgg ctggtggaaa cttgggaaag gagaagagtg atgtctaa 1548

<210> 75
<211> 939
<212> DNA
<213> Streptococcus pneumoniae

<400> 75
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atgccaaata tgagtattgg tattattgta atcctattat cgctgttaac attgtttaag 240

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aggttgaaaa ataaaatttt tattccagtt atgctgatgg caatacttgc gttggtctta 360

gcgcaaatga ttccagaatt tagcaagatt tcgattagcc ttgccgcctt gtttgctaca 420

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tgtgggacct tattgacccc aatggctgct aattttaacg ctctaccagc agcattgatg 840

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gttattcaca tattcttaat gtactttctc gcattttag 939

<210> 76
<211> 1113
<212> DNA
<213> Streptococcus pneumoniae

<400> 76
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acaattatga ttccattttt attaggggc ttttttttatt atttgacaaa ccctattgtt 180

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<210> 77
<211> 1995
<212> DNA
<213> Streptococcus pneumoniae

<400> 77
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attgtgcaaa tgtaa 1995

<210> 78
<211> 1290
<212> DNA
<213> Streptococcus pneumoniae

<400> 78
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caggaatgtt acgcagaggt tggttcgcaa gctatttctt atacgacagg agttccagcc 1140

atgattggga caaaattagt catgaacgga acttggaaac aagctggagt gtataacctt 1200

gaggagttag atccagatcc attcatggaa gctttgaatg agtatggttt gccatgggtt 1260

gtggttgaaa atccacaaat ggtggactaa 1290

<210> 79
<211> 669
<212> DNA
<213> Streptococcus pneumoniae

<400> 79
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gtcatctgta ctggtctggg cttgcttgta ggaggatttt tcctgctaaa accagctcca 120

caaacacctg tcaaagagac gaatttgcag gctgaagttg cagctgtttc caaggactca 180

tcgaccgaaa aggaagtgaa gaaggaagaa aaggaagaac cccttgaaca agatctaatc 240

acagtagatg tcaaaggtgc tgtcaaatcg ccagggattt atgacttgcc tgtaggtagt 300

cgagtcaatg atgctgttca gaaggctggt ggcttgacag agcaagcaga cagcaagtcg 360

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<210> 80
<211> 1524
<212> DNA
<213> Streptococcus pneumoniae

<400> 80
aaaagcttaa agactatgtt acagtggatt aagaatttct ctattcccct aatttacctg 60

agttttctat tactttggct ttattacgct attttctcag catcttatct tgctttgttg 120

ggctttgttt ttctgctagt ctgtctcttt atccaatttc cgtggaaatc tgctggtaaa 180

gttctaataa tttgcggaat ctttggattt tggtttgttt ttcaaaattg gcaacagagt 240

caagcgagtc aaaatctggc ggattctgtt gaaagggtac ggattttgcc tgatactatt 300

aaggttaatg gtgatagtct atcctttcgt ggcaagtcta acggtcgtgc tttccaagtc 360

tattataaac tccagtccga ggaggagaaa gaagcctttc aagctttaac tgacctgcat 420

gagataggac tagaagggaa gctttcggag ccagaagggc agagaaattt tggtggcttt 480

aattaccaag cctatctgaa gactcaggga atttaccaga ctctcaatat caaaacaatc 540

cagtcacttc aaaagattgg cagttgggat ataggagaaa acttgtccag tttacgtcga 600

aaggctgtgg tttggattaa gacgcacttt ccagacccta tgggcaatta catgacagga 660

ctcttgctgg gacatctgga caccgacttt gaggagatga atgagcttta ttccagtcta 720

ggaattatcc acctctttgc cctatctggc atgcaggtag gtttttttcat gaatggattt 780

aagaaacttc tcttgcgatt gggcttgacc caagaaaagt tgaaatggct gacttatccc 840

ttttccctta tctatgcggg actaactgga ttttcagcat cggttattcg cagtctcttg 900

caaaagctac tggctcaaca tggggttaag ggcttggata attttgcctt gacggtgctt 960

gtcctcttta ttgtcatgcc aaactttttc ttgacagcag gaggagtctt gtcctgcgct 1020

tatgctttta tcctgaccat gaccagcaaa gaaggggagg ggctcaaggc tgttactagt 1080

gaaagtctag tcatctcctt gggcatattg cccattctat ccttctattt tgcggaattt 1140

caaccttggt ctatcctttt gacctttgtc ttttcctttc tttttgactt ggtcttctta 1200

ccgctcttgt ctatcttatt tgtcctttcc tttctctatc cagtcattca gctgaacttt 1260

atctttgaat ggttagaggg cattattcgc ttggtctcgc aggtggcaag gagaccactt 1320

gtctttggtc aacccaacgc atggctttta atcttattgt taatttcctt ggctttggtc 1380

tatgatttga ggaaaaacat taaaggatta acagtattga gtttattgat tacaggtctc 1440

tttttcctta ccaagtatcc actggaaaat gaaatcacca tgctggatgt ggggcaagga 1500

gaaagtattt tctacgggat gtaa 1524

<210> 81
<211> 261
<212> DNA
<213> Streptococcus pneumoniae

<400> 81
aataataggg attttaagga gtttgatatg tataacctat tattaaccat tttattagta 60

ttatctgttg tgattgtgat tgcaattttc atgcaaccaa ccaaaaacca atccagcaat 120

gtatttgatg ccagttcagg tgatttgttt gaacgcagta aagctcgcgg ttttgaagct 180

gtaatgcagc gtttgacagg gattttagtc tttttctggc tagccattgc cttagcattg 240

acggtattat caagtagata a 261

<210> 82
<211> 867
<212> DNA
<213> Streptococcus pneumoniae

<400> 82
aatagaaata gttggaggaa atatatgctc tcatggttag cacgcgttat taaagggatt 60

gtaattgctc ttggatttat cctaccggga atttccggag ggttctagc agcaatctta 120

ggaatctatg aacgaatgat tggctttctg gcccatccct ttaaagactt taaagaaaat 180

gttttgtact ttattccagt tgccatcggt atgcttctgg gaatcggctt attttcctac 240

ccgattgaat acctgcttga aaattatcag gtttttgtat tatggagctt tgcgggagct 300

attatcggta cagttcctag cctcctcaaa gaatcaactc gagaatctga ccgagacaag 360

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aattttgtcg ttggaacctt aagcgccagc tttcttaact tcgtcctagc aggcgcacta 480

ttggcccttg gcgtcttggt tcctggcctc agcccatcaa atttactttt gattttggga 540

ctctatgctc ctatgttgac tggttttaaa acttttgatt tcttgggaac cttctttccg 600

attggaattg gtgcaggtgc aactctcatc gtttttcaa aattgataga ttatgcctta 660

aacaactacc actcacgcgt ctatcatttc atcatcggta tcgtcctatc aagtaccctt 720

ttgatcttaa ttccaaatgc aggaaacgct gaaagtatcc aatacacagg actttcactt 780

gtcggttatg tcatcatcgc cttcttcttt gcgctgggaa tctggcttgg tatttggatg 840

agtcaattgg aggataaata taaataa 867

<210> 83
<211> 636
<212> DNA
<213> Streptococcus pneumoniae

<400> 83
atcatgtttt acttgagttt gtcaaggatt gctttaagct cctctactag tttagtttct 60

gtctctgctg agccatttc ttctttcacg aaatcaaggg tttcttggag aaggttttgg 120

gctttggcaa ggactttttt atccgctttt tctgcatcta gctgtcctag aaccttgatc 180

aattccgtgc ttaattgctg gatttctgac tctttcttac ggcgaatcag ccagaaggca 240

atcacgccta ggagggcaag tagactgacc acaatcactc ctgccggaac tgagtttgtt 300

tcagtcatct tatctgaatc cttactatct tccgttcctt gttttgcatc cttcttgtcc 360

tgtgcaggct tgctgtcgct agcatttgct ttcacatctt tgagagagtc caaggcagcc 420

cagccttcac agactctact gcagtatgca gaccttactc tgtcaaggca ctatcttccg 480

gagcttttttg agcatctagg aggacagcct tggttgcatc gattttcgga tcagatactg 540

ttgccaaagc tttcaagcgt tggtctaact cttgactcaa ggcacgaagt tcagacttgt 600

caacttgctc ttgagcttgt gtgctcgttg agctag 636

<210> 84
<211> 744
<212> DNA
<213> Streptococcus pneumoniae

<400> 84
aataggatta gaattattaa gaaagttggt tctttattgg aaacgatagt atttttaatc 60

tctgtttttc tagcaggtgt tttatccttt ttttctcctt gtatttttcc tcttctgcca 120

gtctatgctg ggattttatt ggatgatcaa gaaagtgcaa aaagcttttc tttgtttggg 180

agaaaggttc tctggtcagg cttgattcga acactttgct ttatcgctgg tatctctctc 240

attttcttta ttctaggctt tggtgctggt tactttggtc atattctcta tgcaaattgg 300

tttcgatatg gcatgggagc tattattatc attttgggtc ttcaccagat ggaaattttt 360

catttgaaga aattagaagt tcaaaaaagt tttaccttta aaaaatcaga ttctaatcgt 420

tattggtcag ctttttttact tggtattacc tttagctttg gttggacacc ttgtattggt 480

ccagttttaa gttctgtttt agcacttgcg gcttctggag gcaatggcgc ttggcaagga 540

gcgatttata ctctcattta cactctgggc atggcccttc ctttcttggt attggcacta 600

gcttcaggtc tagtcatgcc atattttagt aaaatcaagc gtcatatgat gctactaaag 660

aaaattggtg gtttcctcat tgttttaatg ggaattttgt tactattagg acaagtaaat 720

gttctagctg gaatttttga ataa 744

<210> 85
<211> 936
<212> DNA
<213> Streptococcus pneumoniae

<400> 85
atggttaagg agttgttcat gaagaaacaa aatttatttt tagtcctgtt aagtgtcttt 60

cttttgtgct tgggggcttg tggtcaaaag gaaagtcaga caggaaaggg gatgaaaatt 120

gtgaccagtt tttatcctat ctacgctatg gttaaggaag tatctggtga cttgaatgat 180

gttcggatga ttcagtcaag tagtggtatt cactcctttg aaccttcggc aaatgatatc 240

gcagccatct atgatgcaga tgtctttgtt taccattctc atacactcga atcttgggca 300

ggaagtctgg atccaaatct aaaaaaatcc aaagtgaagg tcttagaggc ttctgaggga 360

atgaccttgg aacgtgtccc tggactagag gatgtggaag caggggatgg agttgatgaa 420

aaaacgctct atgaccctca cacatggcta gatcctgaaa aagctggaga agaagcccaa 480

attatcgctg ataaactttc agaggtggat agtgagcata aagagactta tcaaaaaaat 540

gcgcaagcct ttatcaaaaa agctcaggaa ttgactaaga aattccaacc aaaatttgaa 600

aaagcgactc agaaaacatt tgtaacacaa catacagcct ttcttatct agcgaagaga 660

tttgggctta atcaacttgg tattgcaggt atctctcctg aacaagaacc aagtccacga 720

caactaacag aaattcagga atttgttaag acctataagg ttaaaacgat ttttacagaa 780

agtaacgctt cttcaaaagt agctgaaact cttgtcaaat caacaggtgt gggtcttaaa 840

actctgaatc ctttagagtc agacccacaa aatgacaaga cctatttaga aaatcttgaa 900

gaaaatatga gtattctagc agaagaatta aagtga 936

<210> 86
<211> 390
<212> DNA
<213> Streptococcus pneumoniae

<400> 86

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cttgctgtcg gtgttgtaat tgcctctgct tttggtgcta tcgttacttc acttgtaaac     120
gacattatca ctcctcttat tttaaatccc gctttgaaag ctgctaaagt tgaacgtatc     180
gctcaacttt cttggcatgg agtcggctat ggtaacttct taagtgctat tatcaatttt     240
atctttgtgg gtaccgccct cttctttatt atcaagggca ttgaaaaagc acagaagctg     300
actggcataa aggaagaaaa aactgacgaa aaaaaaccaa ccgaattgga agtccttcaa     360
gaaataaaag ctctccttga gaaaaaataa                                      390
```

```
<210>  87
<211>  1023
<212>  DNA
<213>  Streptococcus pneumoniae

<400>  87
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tgcctaggtc ttcttattac aatatttttg tcattaaagc ttggaacaaa agaaattaat     120
atcagagatt ttttagcagc ttttggaatg ggtaatacaa atgatgattt tattaaatca     180
attatatata aaagaatacc tagaactatt tttgcaattt tagcaggttc tagtct[illegible]cc     240
ataagcggtg tattgatgca atcagttact agaaacccaa tagctgatcc aggtatactc     300
ggtataaaca caggagcaag tcttagtgta gtaattggtc tttctttttt aggaatttca     360
tcaagcataa gccatataag ttttgcaatc attggtggct tagtaagtgc aatttttgta     420
tacgcgattg ctgtaagcgg aaaagcaggc cttacccctа taaaacttgc cttatcagga     480
acttgtgtta gtatggcttt aagcagtttt gtaagttttt taattttacc gaataataac     540
gtcttagaca aatttagatt ttggcaaata ggtagccttg gagcagctac attatcttct     600
atatctacac tactaccttt tataatttta ggtcacttga tagctatatt tatttcatca     660
gatttaaacg ctttagctat gggtgatgaa atggctgttg gtcttggagt taatgttaat     720
aggataagat cacttgcaat aattgcaagt gtgcttttat gttcaagtat tactgcaatt     780
ggtggaccta ttggcttcgt aggtcttata gttcctcact tttgtggctt atttataagc     840
aaagatatac gcacaatgac catttcttca tcttttatag gtgcagagct cttgcttata     900
tgtgatataa tcggccgtat gttaggtaaa ccaggtgaaa ttgaagtagg gataattact     960
gcaataatcg gggtccagt acttatttat gtaactatga aaaatagagg ggttaataac    1020
```

taa 1023

<210> 88
<211> 1011
<212> DNA
<213> Streptococcus pneumoniae

<400> 88
ctaatgcaaa atttaattat aggtattcaa aaaagaaaaa atagaataac actattttcc 60

tcactatttt tattaataat aatcagtcta tcatttttca ttttacttat cggagatgaa 120

agttattctt tttcaacttt gattaaagtc ttaaatagtg aaactgttcc tggagctagt 180

ttttcgatta tggaaattag attaccaaaa ttattagcag gaattatagc tggctggtct 240

tttggattgg caggatttat ctttcaaact atgttaagaa atcctcttgc aagtcctgat 300

ataatcggtg tcacaagttc ttcatctatt gcagcggtct tttgcatatt ggtattaaaa 360

acaaatagtt taactactgg aattatttca ataacttgtg gactaacatc atctttaata 420

ttatttttac tagctaaaaa agatggtttt tcagcagcaa gactgataat attaggtatt 480

ggttttcaag ctgtcacaag agcaggcacc tcatttttat tgttgaaagt agcaagatat 540

gaattacaag aagttatgag atggctcagt ggctctttat cttttacaaa gttagatgac 600

atacctcttg ttctaatagt aagtattatt gctactatat tagttttatt ttttaataaa 660

agactagaaa ttattgaact tggtgaagaa atagcaatcg gacttggagc aaatcccgag 720

ctttcaaggc ttgttttaat tttttgcgct gtatctttaa ctgctttttc tacttcaatt 780

acaggaccaa tagcttgtat atcttttttta gctggtccca tagccttaaa tattggcaag 840

aaaagaagcc caatattagc tggattggtt ggaattttac tagttttgtt atcagacata 900

ttctctcaaa atattttacc agctagatat ccagtaggtg ttgtaactgg cttgttaggt 960

tcaccatact taatatactt actaataaaa atgaacagga ggaatatata a 1011

<210> 89
<211> 936
<212> DNA
<213> Streptococcus pneumoniae

<400> 89
aataaaggta ggggtgttat gaattgtttc ttgaaaatga ataatgtaag tgttcgttat 60

gatgacgtaa tagctttaaa agatataact ttacaaataa ataagggaga tttcattggc 120

ttattaggtt caaatggtgc aggtaaatct acgttaatta attctattgt aggttttcaa 180

gagatttatt taggagaaat agagtattgt gataaagatt tgatagttag ttctcaacct 240

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gacaatgtaa tattggggct gaaccttgct ggaaagtttg ggaaaaatgc tgagaagttg 360

tgtcaaatag ccttagaaat tgttgggtta gctgataaaa aaaataattt ggtagaaaca 420

ttgtcaggtg gacaactgca acgcgtccag attgctagag caatagctca taatccagat 480

ttttatattt tagatgaacc taccgttggt ttagatactg aatctgccga aaaattttta 540

atgtatttaa aagataagag tttggaagga aaaactatta tcatatcttc acatgacata 600

aatctactcg aaaagttttg taaaaaaata ctttttttac aaaatggctc catatcattt 660

tttggtgata tgcgtgactt tgtagataat tcaactatca aattaaattt ttcaatgcag 720

aatagaattt ctagatatca aattgaattt ttagaaaatt ttagatttaa agttcacatc 780

gaagataatg atagttttac aatagaagtc cctatagaag aaaagatctt agatgttatc 840

aatgaggtag gaaaagcatg tgaaattaaa aacttttcaa caagtaaatt aaccttacaa 900

gaaagttatt tgcaaagaat aggaggagaa aaatga 936

<210> 90
<211> 846
<212> DNA
<213> Streptococcus pneumoniae

<400> 90
attaacctta caagaaagtt atttgcaaag aataggagga gaaaaatgaa ggctgatcaa 60

ttaaggcaca aatcggactt aggtttaaga ggtctagcga ttattgctaa aaatgagatt 120

attgcttttt ttagaagtaa aggtttaatt atttctcagt ttctacaacc aatcttatat 180

gttgttttta taataatagg attaaattct tcgataaaga acattcagtt taatgatata 240

aaaacctctt atgcagaata tacaatcatt ggtgttatag ctttattgat aatcgggcag 300

atgactcaag ttatttatag ggtgacaata gataaaaaat atgggctact tgctcttaag 360

ttatgcagtg gagttcgtcc tttatattat attttaggga tgagtatcta ttctatatta 420

gggttgatag ttcaagaaat tattatatat ataattacgt tagcgtttga gataaatatc 480

gcaatggata gattttttta tacagttttg ttatctattg ttgttttatt attttgggac 540

tcccttgcaa ttttacttac aatgtttatc aatgattaca gaagacgtga tattgtaata 600

cgttttgtac taacaccgct tggttttaca gctcctgttt tctacttaat agattctgct 660

cctagtattg tgagatggat tggtcagtta aatcccttaa cttatcaatt aactattttg 720

agaaactttt attttaaaaa ttcaacaact ttggaattag ttttcttatt gttaacatca 780

ttacttgtcc ttatatctgt atcttttatt ataccaaaga taaaattgat actgatagaa 840

agataa 846

<210> 91
<211> 1038
<212> DNA
<213> Streptococcus pneumoniae

<400> 91
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attgctgcat tagcagtctt agtagcagga agcttgattt attcttcaat gaataaatca 120

gaagctcaga ataataagga tgagaagaaa ataaccaaga ttggtgtgct tcaatttgtg 180

agccatccat cccttgattt gatttataaa gggatccaag atggacttgc agaagaagga 240

tataaagatg atcaagttaa aattgatttt atgaactcag aaggtgacca aagtaaggtt 300

gcgacaatga gtaaacaatt ggttgcaaat gggaatgacc ttgtggttgg tatcgcaaca 360

ccagcagccc aagggttggc tagtgcaaca aaagacctac cggttatcat ggccgctatt 420

acagacccaa ttggtgctaa cttggttaaa gatttgaaaa aaccaggtgg caacgttaca 480

ggggtatctg accacaatcc agctcaacaa caagttgaac tcatcaaggc tctgacaccg 540

aatgtgaaaa caatcggagc tctttactca agtagcgaag acaattcaaa aacacaggtc 600

gaagaattta aggcttatgc tgaaaaagca ggtctgacag tggaaacatt tgcagttcct 660

tcaacaaatg aaattgcctc aactgtcact gttatgacta gcaaggtaga tgctatttgg 720

gttccaattg ataacaccat tgcatcagga tttccaacgg ttgtctctag caatcaaagt 780

tctaagaaac caatttatcc cagtgcgaca gctatggtag aagtaggtgg tttggcatca 840

gttgtaattg accaacatga ccttggtgtg gcaacaggta aaatgattgt gcaagtcttg 900

aaaggtgcaa aaccagccga taccccagtc aatgtctttt caactggtaa gtcagtcatc 960

aataaaaaaa tagcacaaga actaggtatt actattcctg agtctgttct caaagaagca 1020

ggacaagtca tcgaataa 1038

<210> 92
<211> 792

<212> DNA
<213> Streptococcus pneumoniae

<400> 92
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gcaaccaaaa tcgttaaaaa tggctttgat gaagaaaaga ttattttaaa tgatgtttcc 120

ttagaaattt ttgaacggga ctttatcacg attttgggcg gaaatggtgc tggaaaatca 180

actctcttta acactatagc agggacctta tcactaacta gtggaactat ccgtatttta 240

ggtgaagatc tcactaagtt ttcacccgag aagcgtgcca agtacctgtc tcgtgtcttc 300

caagatccaa agatggggac agctccccgt atgacggtcg ctgaaaatct tttaatcgcc 360

aagtttcgtg gtgaaaagcg tggattgtta ccacgacgct tgactagcta taaggatgaa 420

tttcaggcaa ccattgaaaa agtaggaaat ggtcttgaga aacacttgaa tacaccgatt 480

gagttcttat caggtggaca aagacaggct ttgagtctct tgatggcaac cttgaagcga 540

cctgaattac tcctgttaga tgagcatact gctgccctgg atccaaagac tagtgttgct 600

ttgatggaat tgacagatga atttgttaag aaagatcagc taacagccct tatgattact 660

catcatatgg aagatgctct caaatacggc aatcgcttga ttgtcatgaa agaaggacga 720

attatccaag atttaaacca agaagaaaaa gcaaaaatga aaatctctga ttattatcaa 780

ctctttgaat aa 792

<210> 93
<211> 741
<212> DNA
<213> Streptococcus pneumoniae

<400> 93
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cctataagaa aaatatcacg tcagtctaaa aggttagcac ttttttttgac gttttgtgct 120

ggatatgtgg atgcttacac ttttattgtt cgcgggaata cccttgtagc tggacaaact 180

ggaaatgttg tctttctttc agtagaatta attaaaaata atgtttcgga tgttagggac 240

aaggttctca ccttgctagc gtttatgatg ggagtctttt tattaacgat ttataaggaa 300

aaattgagaa ttgtgaaaaa acctattctg tccttgattc ccttggcaat cttatcaatc 360

attattgctt ttgtgccgca aactgtggat aatatctatc tagtgccgcc cttggccttc 420

tgtatgggac tggtgacaac tgcttttgga gaagtgtcgg gtattgccta taataacgct 480

tttatgacag ggaatatcaa acggaccatg ctggcttttg gagattattt ccgaaccaag 540

cacactcctt ttttgcgtga aggattcata tttgttagcc tgcttagtag ttttgtcctt 600

ggcgttgtct tttcagccta tttgacgatt ttctatcatg aaaagaccat tcttggtgtt 660

cctattatga tgagcgtttt ttacctcagc atgctttttg cctcttggca gaaaaaagta 720

aaagaaaaag cttcatttta g 741

<210> 94
<211> 864
<212> DNA
<213> Streptococcus pneumoniae

<400> 94
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gctatttatg cttttggact gacttatttt gtagttcccc atcatctctt tgaaggaggg 120

gcgacaggca ttaccctcat cacctttttat ctttttaaaa tccctgtttc cctcatgaac 180

ctgctgatta atattcccct tttcatccta gcttggaaga tttttggagc caaatccctc 240

tattctagtt tactaggaac cttagctttg tccggctggt tagcttttttt tgagcatatt 300

cccccttcata ttgatcttca aggtgattta ctaatcacag cccttatagc gggaatccta 360

ttgggaattg gccttggaat tatttttaat gctggaggta caactggcgg aactgatatt 420

ctagctcgta ttctcaacaa atacactcat atatccatag gaaaactgct ctttatctta 480

gatttttgta ttctcatgtt gattctccta atcttcaagg atttgagatt ggtttcctac 540

acgcttttgt ttgattttat tgtttctcgt gttattgatt tgattggtga aggaggatat 600

gccggcaaag gctttatgat tatcacaaaa cgtcctgacc aacttgctaa ggcgattaat 660

gatgacctcg gaagaggtgt tacttttatt tctggtcaag gctactatag taaagaaaat 720

ttgaaaatca tctactgtat tgtcggaaga aatgaaattg tgaaaacgaa ggaaatgatt 780

catcgaatcg atcctcaagc ctttataact attacagaag cccatgaaat cctaggagaa 840

ggcttcacct ttgaaaaaga ataa 864

<210> 95
<211> 300
<212> DNA
<213> Streptococcus pneumoniae

<400> 95
aaattatttg gaggaatcat taacatggca aacaaacaag atttgatcgc taaagtagca 60

gaagctacag aattgactaa gaaagactca gcagcagcag ttgaagctgt atttgcagca 120

gtagctgact atcttgcagc tggtgaaaaa gttcaattga tcggttttgg taactttgaa 180

gttcgtgagc gcgcagaacg taaaggtcgc aacccacaaa ctggtaaaga aatgacaatt 240

gcagcttcta aagtaccagc attcaaagct ggtaaagctc ttaaagacgc tgttaaataa 300

<210> 96
<211> 1095
<212> DNA
<213> Streptococcus pneumoniae

<400> 96
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ctaaaacaac tcatgccctg gtatgttctg gaatactacc aatctaagct ggctgtgccc 120

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gctaaatact cagaggattt taaagtgcgt gtaacacccc ataaactgcg ccatacacta 960

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gctagcacac aagtcactga cctctatacc catattgtta gtgatgaaca aaagaatgct 1080

ctggatagtt tatga 1095

<210> 97
<211> 405
<212> DNA
<213> Streptococcus pneumoniae

<400> 97
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tatttaccaa ggatttcagc catcattccg ttgaggtcaa tccctttagc aatagcttgc 180

ccgtgtccac ggtggtttga ggtaatcaga tcatctggat tgagagctaa catagccccc 240

acgttagctg cctcttcacc aacagaaaag tgcgtcattc ctggcacttt ccctttcttt 300

actaattgtg caatttttaa gtccatgcga cggatttctt ccatcttacg gaacatttct 360

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<211> 1716
<212> DNA
<213> Streptococcus pneumoniae

<400> 98
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gcaggtatgc ctgttattct cttctcaagt atctttatct tgattgcctt tgtaccaaac 180

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aaggtttgtg ttaagaacaa cgtcactatt cgtatgcctg acgaagttcc accaaatatc 540

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ttggtcgttc catttatgtt catgtggttg acaaaatcga aacgtaaccg tgcaatcgga 960

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<211> 807
<212> DNA
<213> Streptococcus pneumoniae

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tttttaacct tcagtactgc tgcaggtgca gttggggctg acttgattaa taaaattgca 180

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atcggagcct tgatagcagg gtggggcttt gctcattcgg cagcctatgc gaatctgaca 420

cacgatagtt tcatctcagg tgttgttgag atgaagttag gccgctcaaa tgaattggtc 480

ttgcttgagg cgattttggc aaatattttt gtaaatattg cgattctgtc atttattttg 540

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gctgcggatt caattgccaa cttcggtgtt ggaaatatgc ttcgccactg gggtgtgact 720

ttcatcggaa actttatcgg aggaggcctc ttgatgggtc ttccatatgc cttcctcaat 780

aaaaacgaag atacttatgt agattaa 807

<210> 100
<211> 1356
<212> DNA
<213> Streptococcus pneumoniae

<400> 100
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attcagttga agcaagtcaa tcaaaaggtt aaagatttga ttgcaggaga ttattccaag 180

gttcttgata tgcaaggtgg gtctgaaatc accaatatta ccaataattt gaatgacttg 240

tcggaggtta ttcgtctcac tcaggaaaat ctagaacaag agagtaagag gctaaatagt 300

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attttggaat tgctcaagat agaagaaaac tatgaattgc gtgatttgat tacccaaagt 480

ccagaattgt tgctagattc ccaagatatc aatggcgaat atttgaacct tcgagttcgc 540

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acgacggagc aggagaagga agaacgcgaa cgaagactct ttgtttccaa tgttagccat 660

gagttacgga ctcctctgac tagcgtaaaa tcctatcttg aagccttgga tgaggggggct 720

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atgcgcatgg tgacggatct cctccatctt tcacgtattg ataatgctac cagtcaccta 840

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gctattaagt attcgccaga tgggggtaaa atcactgtca gaatgaagac aactgaagac 1080

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aaagaagaag tatgggagga tgaagtagaa gactag 1356

<210> 101
<211> 594
<212> DNA
<213> Streptococcus pneumoniae

<400> 101
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cccgataccc tagataaacc aaaatcttcc tggattttca actttgtttt ggctgttgtt 420

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gaaaatatgt tttatgttct atttgtacta gttggatttg gtacaattat ccatagtatg 540

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<210> 102
<211> 867
<212> DNA
<213> Streptococcus pneumoniae

<400> 102
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aagaacaaaa gaatatttaa agacttccaa gcttcaaaaa tgagtttaaa catttacaca 120

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ggtattggct tgttagctct catcggactt gctagaaatt ttggagaggc tggtcaaaat 240

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aaagttgaga aaagacctat tcgaaccttg ggattttata gagagaattt cctcagcaat 420

cttctgaaag gatttagtct aggcctggca ctttttcttc tgaccttgtt aggtttagtg 480

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tggctacttc ctcaattggc ctcaagaacc aatctaaaac tagctattct tatatctagc 660

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<210> 103
<211> 2193
<212> DNA
<213> Streptococcus pneumoniae

<400> 103
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accgcctatg caccttttga gtttaaagat tcagatcaaa cttataaagg aattgatgtt 180

gacattatta acaaagtcgc tgagattaaa ggctggaaca ttcagatgtc ctatcctgga 240

tttgacgcag cagtcaatgc ggttcaagct gggcaagccg acgctatcat ggcagggatg 300

acaaagacta aagaacgtga aaaagtcttc accatgtctg atacttacta tgatacaaaa 360

gttgtcattg ctactacaaa gtcacacaaa attagcaagt acgaccaatt aactggcaaa 420

accgttggtg ttaaaaacgg aactgccgct caacgtttcc ttgaaacaat caaagataaa 480

tacggcttta ctattaaaac atttgacact ggtgatttaa tgaacaacag cttgagtgct 540

ggtgccatcg atgccatgat ggatgacaaa cctgttatcg aatatgccat taaccaaggt 600

caagacctcc atattgaaat ggatggtgaa gctgtaggaa gttttgcttt cggtgtgaaa 660

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<210> 104
<211> 774
<212> DNA
<213> Streptococcus pneumoniae

<400> 104
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gaaggagatg ttgtttgtat catcggtcct tcaggttctg gtaagtcaac tttcctccgt 180

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gccatcgctc gtggcctagc aatgaatcca gacatcatgc tcttcgatga accaacttct 540

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gttatcttta ctgcagatgg cgagttcctt gaagacggaa cacctgacca aatctttgat 720

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<210> 105
<211> 372
<212> DNA
<213> Streptococcus pneumoniae

<400> 105
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gacaaagaat ag 372

<210> 106
<211> 555
<212> DNA
<213> Streptococcus pneumoniae

<400> 106
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atggactgtt tcatggcaaa ttcaccaatt ttacctttca aaccgccacc aaacatctgg 180

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tttccagaac cagcagcaat acgacggcga cggcttggat ttaacaaatc tgggttttca 480

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<210> 107
<211> 396
<212> DNA
<213> Streptococcus pneumoniae

<400> 107
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gctgctatgt tgggcggact tgtccgatat ctagtttcca cctggttacc agccagtcca 120

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gatacagggc gttatcttag tttgatactg tatttgcttt tgagtatcgg tggaggcctg 360

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<210> 108
<211> 1998
<212> DNA
<213> Streptococcus pneumoniae

<400> 108
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caggataact ggtcagaagc tctagaaaaa gatgaagttg tatttccaac tattcaaatt 180

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gttattacaa agaattaa 1998

<210> 109
<211> 915
<212> DNA
<213> Streptococcus pneumoniae

<400> 109
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acaattattg actatgattt gggaacgaat cagatattaa atcaggtctg tgatttaatt 180

ggtgagtata ctttaaatca ttcaattgat ggtgttggga tttccactgc tggagttgtt 240

aatgctaata ctggagaaat catctatgca ggctatacaa taccagggta tatcggagta 300

aactttactg ccgaaataga aaaacgtttt gggttgtata cttttgttga aaatgatgtt 360

aattgtgctg cattaggtga attgtggaag ggacaagcca aagataagaa aaatgtagta 420

atggttacta ttggaacagg tataggaggc agtattattg tcaacggaca aattgttaac 480

ggatttaact atactgctgg tgaagtaggt tatattcctg taggtaattc ggattggcaa 540

agtaaagcct caacaaccgc attgattcat ttatatcaaa aaaagagctt gaaaactaat 600

caaactggac gtactttctt cactgattta agatctggag ataaagttgc tgaagaaact 660

tttgaaattt ttgtagaaaa tctaacaaaa ggtttattaa cgatttctta tctacttaat 720

ccagaaattc tcatattagg aggtgggatt ctggatagta aggatatttt gttacctgaa 780

attcaaagtt ctttagctaa aaatgcaatg gataataggt ttttacctaa aaatcttgtg 840

gcagctacat taggaaatga agctggtcgt ataggagctg taaaaaattt cttagataga 900

atttctaata aatag 915

<210> 110
<211> 930
<212> DNA
<213> Streptococcus pneumoniae

<400> 110
aggagaaatc tgatgaaaga tttaactaaa tacaaaggcg ttatccctgc attttatgct 60

tgctatgatg aaaatggtga aattagccaa gatcgtgtaa aatctctggt acaatatttc 120

attgacaaag gtgtaaaagg tatctatgta aatggttctt caggtgaatg tatttaccaa 180

agtgtagaag atcgtaaaca aattattgaa gctgttatgg aagttgctaa aggtaaatta 240

acagttatca accatattgc atgtaataac acgaaagata gtatcgaatt ggcaaaacat 300

tcagaaagtg ttggagtcga tgctattgca gctatcccac ctatttattt caaattgcca 360

gagtattcaa tcgcagcata ttggaatgca atgagtgaag ctgcgtcaaa tacagatttt 420

attatctata atattccaca attggcaggg gttgcgttga ctggtagttt gtatgcaaca 480

atgcgtcaaa atcctcgtgt gattggagtt aaaaattctt ctatgcctgt acaagatatt 540

caaatgtttg tagctgcagg tggagaagat tacattgtat tcaatggtcc agatgaacaa 600

tatcttggtg gtcgcttgat gggagcagaa gctggtattg gtggtactta tggcgttatg 660

ccagatttgt tcttgaaatt ggaaagtttg attcaagaac gagatttaga tacagctaaa 720

aaacttcaat atgctatcaa tgaagttatc tataagatga tatcaggtaa ggcaaatatg 780

tatgctgtag caaaagaagt tttgcgtcta aatgaaaaac ttgatttagg ttctgttcgt 840

caacctttag aagcattggc agaaggtgac ttggaagttg caaaacaagc agcagaactt 900

attcaacaag cacgaaaaga atttttataa 930

<210> 111
<211> 759
<212> DNA
<213> Streptococcus pneumoniae

<400> 111
gtgattggag gcaagaatat ggataaagat tatatattaa aagtgaaagg gctgtatcat 60

caatttttac taggaaataa taaaacgttg caagtgctga aaaatgtttc tctttctgct 120

tcgagaggag aatttataag tattctagga attagtggtt ctggaaagtc aactttatta 180

aaatgtattt ctagtttgct tgaaccaaca agtggggaag taattttaaa tggaatcaac 240

ccctataaaa tcagaaatgc aaaattgtca agtataagac gtaacgaagt atcttttata 300

tttcaagcat acaatttaat accttccctg ccggtaatag aaaatatagc acttcctttg 360

cgattatcac aaaaaaaatt aactattaaa aatgtagaaa acttactcaa aagaatgaag 420

tttaatgctg gcttaaacga ttttgttgga actctgtctg gtggagaaca acagaaggtt 480

gctatagcta gagcggttat tgctgatagt gatataatat ttgctgatga gccaactggg 540

gctttagaca gcgtttctcg tgaagtaatt tttgaattat tgagagagtt agtaggggcg 600

ggtaagtgtg taattatggt aacgcacgat atagaattgg cctcgaaaac tgatcgtgca 660

ttaatattga aagatggaaa aattttcaaa gaacttcata gacctagcgg ggaagagttg 720

tataaaatct tagaggtaca atcaactacg gaggaatag 759

<210> 112
<211> 1611
<212> DNA
<213> Streptococcus pneumoniae

<400> 112
cttatgaatt atttaaaatt tataaaaaag actaaactta tattaatggg gattttaata 60
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aatcagactt cctcattttc tgacgttcta agatttggtg ctataagtat tctgggttgg 180
tcagcaatct atatatcaaa ttactattta gaagtaacgg aagcatcaat aactaaagat 240
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agcaatgcag agtatactca cataataaaa gaaattttta atggttttaa gacattaaaa 600
tcttattctg ttactaaaga aataattagt ttgtcggata aaaagttgga taaactagaa 660
gattctactt ttaatttgaa acgatcagag gttctttcaa aattggttgc agtactaatt 720
tcaggttttt gctttctagt tcccttggtt gtaggatgtt attttgtaat ttatcataaa 780
agcctttctt ttagtgaact gataggtatt ttcttagcaa acgataaagt tttagggccg 840
atacaatcaa ttgcctattc attaaataag ataaatacaa ccaaagattt aaggaaaccg 900
tttttaaaat acttaagtgg agagaagaat tttatagacg ctgaacatga taataacgga 960
ctgtatactt catcaataga tgagatacac atgaaagatg ttgtatattc tattacacca 1020
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gatcagacac catatatttt tgacactact attcgtgaga acgtaacttt atttcaaaat 1260
gaatattttt cagatgatca gataattgag gtgttaaaaa aggtaaatct atatgaagaa 1320
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ggtcaaaaac aaaaaatagc tttagctaga gctctgatta gaaataataa agtgtactta 1440

tttgacgaaa tatcagctaa tttagataat gataattcaa attccataca tgatattctg 1500

ttcaatttag gtatttcatt tattgaagtt tcacatcatt atgacttaaa tgacaagaga 1560

tacactgata tatataaatt ggaaaatgga acacttttca aaattaagtg a 1611

<210> 113
<211> 1953
<212> DNA
<213> Streptococcus pneumoniae

<400> 113
ggggtcatac ttgtgaatca gagtaatgaa atatttttaa atacaataca ggaaaaaaca 60

cactataaga ggtctatctc ttcatcattt caggaattaa aaaaatggaa ttctttgata 120

tttaggagag ggcgatattg gtaccaattt gataattgga gtatacccaa tactggtgta 180

ataaaggaat ggtatgtcga agataatgac tggattccta aggttagttc ttccagttta 240

gacaattcaa attcacttaa aattgtcttt gatgtggaaa aatatacttt gccagatgat 300

agtatcttac aggatgttag gatttcatct gatgagagtt atatagtttt ggttgtatcc 360

tcactgcgta cgactaattt aattggaata aaaaaatata ctatggaaga gttatttatc 420

attgaagata tttcagtaga aagttcgttc tatttgggta aattcggtgt tatgtatact 480

cgctccaaag agtacgggag gccaagtaag ttattctata aatcttttga tagctttaca 540

gaagaggaac tgtttgaaga aaacgaatgc tcttttcgat taaaaatagt ccacattgat 600

agcaataatt gttttgtaaa gtcagtagac tttcagaaag gcaggatttt tctatacagt 660

ttcgaccgga cgggttttgt tagacactct tacacagaaa cggtagcccc aacacctaga 720

gatatcgctc tatttagtac agaaaaagca cagtactttc ttgggctctc ttcaactgaa 780

gaaaagaaag atcaactaat tctaagggaa acttcttcgg gagacagagt ttctattact 840

ataccatatc aagatagggc tagaagagtt cactgtatag gacgttatat ccttttagac 900

tgttcaaacg cagcgaattc cgtcttttat cttgctacat ttaaaaataa tagtttgagg 960

gagttgagtg ttaataagat aacatttgat gaaaagacaa cactttatga aaattcattt 1020

tctgatcgtg ttcttctgtt tttagagagg agaacttttt acgaaaaaat acttagtttt 1080

gatttaatag aaaatacatt aaaaactgaa tttgaaagac ccatcataaa atcgaataat 1140

actaaatatt tttctaaggt gatttggact aaaaaagaca gttatgatgt aagcataccg 1200

atttctttat tttggaaaag tgaagatacg gatgagctcc caagaagaaa aaaatgtatt 1260

ctaagtgtct atggggctta tggtaagaat gataattctg atttagatga aattatgtta 1320

tctataatag atgcaggttt tatttatgct atagttcatg taagaggtgg aggctatttg 1380

ggtggtgaat ggtatcgctc aggaaaggcg ttaaacaaat ggaattctat cagagatttt 1440

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ataacttcta gtgcaggtgg aataattgct ggtgcggtgt tgaacgagga aaaaaattta 1560

ttgcaaagca ttctcttatt ttcgccattt ataaatcctt atgatacact tcagaatcca 1620

aatgatcctc tttctaagac cgaaatagca gagtggggag atattagaga ccctgaagta 1680

aaggcttata taaagtcata ttcgcctatg caaaatattg aaaaggcacg agactcaaat 1740

actgttatag ttaatatttt gggtgagaaa gacccatata ttaataataa cgaagtgata 1800

gagtggtcaa agaaattaaa ttctattgga gttaaaagtt tgttgtattt aaacaaagca 1860

gctggtcatg gaggttttac tccatcagat gttctcttaa tgattgatac tttaaattat 1920

ttctttgaag aagtgggaag gaataactta tga 1953

<210> 114
<211> 1449
<212> DNA
<213> Streptococcus pneumoniae

<400> 114
aacgggggtg accaagtgat tgatgggaaa cgattattat ttagtttgac catagtcagt 60

tatgccttga cgctagtaag tggaattgtg tatctgttta ataataataa tgttagctta 120

ctttctactt tattgttctt gttggttagt agcttaattg cttgttggaa tgatatcaag 180

tattacttaa tccattttat tttctattta accatttttg tatttctggt atcaagaccg 240

accattgatt attttaggga tggtgctttg gatacctatc atccaatagc ctatcgtttt 300

gcctttatag ttgtcatgat ttcgattctg ggcttgacca caggaggcat tctggctcgt 360

tacttcatag ctaggaagaa aataaaagta gcaaatatag gaaattctct aaaagaggtt 420

tatatcaagc ggttacgctt tgtatcacta ggagtttttc ttctaactta tcctttctat 480

ttcattcggt tatttgaacg gctcttgtat cgtttgcaga cttcctacta tgcctactat 540

gcaaattttg aaagtaaact gccttatttt acctacattt tgtctacctt tacggtctat 600

gcaatgtgta tgtatctggc aaccaagcca aagaaattgc aggccacagc agtgcttgtc 660

tcctttattg cagctaatac tattcatttg gcaattggga cacgaaatcc ctttatttta 720

agtattttat ttgcttttgt ttattacttt atgcgggagc aaactgaaaa aggaaaatgg 780

attgggttta aagaaaagtt agcgattttt gtaggttctc ctattctcat gttagcgatg 840

ggagtactca attatgtacg ggataatgtc caagtttccc atacaggttt ctgggatatc 900

ttacttgact ttatctataa acaagggact agttttggtg ttctggctcg aggttttcta 960

tttaacagta gcctccctta ccgagatttc cgtaatttta cttttggtcc tgttcttgat 1020

tattttgcaa gggggagttt gggagccatt ttcggaggaa aagcctttga acatacaacc 1080

aatagtgtgg aactagctat tgatagtaat agttatgccc acaatctatc ctatcttgtc 1140

ttgaacaagg aatacttgaa agggcatggt atcggaagta gttatatcat ggagttgtat 1200

accgactatg gtatgattgg agtctttctg cttagtttct tactcggcgt attatttata 1260

gccatgctgc aagtagccta tcgctcaagg acaatcctat ttgctttatc cctactcatc 1320

ttgaataatc tattctttat gccaagaagc agcttttcag aaagtttctt caatttattt 1380

acaatgcaat tctggggaat tgttcttgtg attatatttg tagcaaaaat gcttacaaag 1440

gaaaactag 1449

<210> 115
<211> 831
<212> DNA
<213> Streptococcus pneumoniae

<400> 115
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tacatgcttt ggattgcgct ctttgtattg gcacccttgg tcttgatttt cggtcaatcc 120

tttttcaaca tcgaaggcca gttcagttta gaaaattaca aatcttactt tgcgtcacaa 180

aacttgacct atcttaaaat gagtttcaac tcagtgcttt atgcaggcat tgtgaccttt 240

gtggcactgc ttatcagtta tccgacggcc ctctttttga cccgtctcaa acaccgtcaa 300

ctctggctca tgctgattat ccttcctacc tggatcaatt tgctccttaa agcctatgct 360

tttatcggga tttttggtca aaatggctct attaaccaat tcttggaatt tatcggaatt 420

ggttcacaac agttgctttt taccgatttt tcctttatct ttgtcgcaag ctacatcgag 480

ctccccttta tgattttgcc gattttcaat gtcttagacg atatggataa taatctcatc 540

aatgctagtt atgaccttgg tgcaactaag tgggagacct tccgtcatgt catcttccct 600

ctatctatga acggtgtgcg aagtggggtt cagtcggtct ttatcccaag tttgagtctc 660

ttcatgctga cccgtttgat tggtgggaac cgcgttatca ccttggggac ggctattgag 720

cagaattttc taaccaatga caactatggt atgggttcaa ccatcggtgt gattctcatc 780

ctgaccatgt tcatcaccat gtgggtgact aaggaaagga gagaacgatg a 831

<210> 116
<211> 771
<212> DNA
<213> Streptococcus pneumoniae

<400> 116
aaaggaaacc gtatgacaga tgcgatttta caggtatcag acctgtccgt ttattataat 60

aaaaagaagg ctttgaatag tgtttcccta tctttccaac ctaaggaaat tacagccttg 120

attggtccat ctggatcagg gaagtcaacc ctcctcaagt ctctcaaccg catgggagat 180

ctcaatccag aggtgaccac aactggatcc gtggtgtaca atggtcacaa catctacagt 240

ccgcgtacag atacggttga attacgtaag gaaatcggaa tggttttcca acaacctaat 300

cctttcccta tgactatcta tgagaatgtt gtctacgggc ttcgtatcaa tggaattaag 360

gataagcagg ttctggatga agccgtagaa aaagccttgc aaggtgcctc tatctgggat 420

gaggtcaagg atcgtctata tgattcagct attggattgt caggtggtca acagcagcgt 480

gtctgcgtgg cccgtgtctt ggcaactagt cctaaaatca tcctcttgga tgagccaact 540

tcggctttgg atccgatttc agctggtaaa attgaggaaa ccttgtatgg tctaaaagac 600

aagtacacca tgcttctggt aacccgttcc atgcagcaag cttcacgtat ctctgataag 660

acaggatttt tcctagatgg agatttgatt gaatttaatg ataccaagca gatgttcctt 720

gatccccaac acaaggaaac ggaagactat attacaggaa aatttggata a 771

<210> 117
<211> 912
<212> DNA
<213> Streptococcus pneumoniae

<400> 117
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gctgtcctct atacgattgc tagcatcatt gtgacaatct tggcttcctt gattctctat 120

atcttggttc ggggcttgcc ccatatctct tggtctttct tgactggaag gtcttctgct 180

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tcagtggtgg tgggtctctt tggttacttg atctttgtag tccagtttga gtatggattt 420

tcaatcattt caggtgcctt ggccttgaca gtctttaact tgcctcagat gacgcgtaat 480

gtagaggata gtttgaaaca cgttcaccat acccaacgtg aggctggtct ggctcttggg 540

atttctcgct gggagacagt ggttcatgtt gttattccgg aagcgcttcc aggtattgta 600

acgggtgtcg tcttggcatc tggtcgtatc tttggcgaag ctgcagctct gatctataca 660

gcagggcaat cggcgccagc tcttgactgg tctaactgga atatcctcag tgtgactagc 720

cccatctcta tcttccgtca agcagaaacc ttggctgtcc atatctggaa agtcaatagt 780

gaaggcacta ttccagatgg aaccattgta tcagcaggtt ctgccgctgt gctcctgatc 840

tttatcctga tttttaactt tggagctcgt aagttcggaa gctatctaca caagaaatta 900

accgctgcct aa 912

<210> 118
<211> 1800
<212> DNA
<213> Streptococcus pneumoniae

<400> 118
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aaactatttg cttatgtcca agataagaaa tatcttgggg ttttggccat aatttttct 120

gctatatctg ctgcacttac agtatatgga tattatttaa tctacaaatt tctagataag 180

ttaataatta attcaaactt atccggtgca gagagtatag cattaaaatc tgttattaca 240

ctaacaagtg gagcgatatt ttattttgtc tcaggaatgt tttcacatat cttgggattc 300

aggcttgaaa caaatttaag aaaaagggga atcgatggtc tggaaaaagc aagttttagg 360

ttctttgact taaatccatc tggtcaaata agaaagatta tagatgacaa tgctgcacaa 420

actcatcagg tggtagcaca catgattccc gatagttctc aggcaataat cacacccgta 480

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aatgataaag ctgtcattga aaatttatcc tttaatttag aagaaggaaa gtcctacgca 1140

cttgtcggtt catctggatc aggcaaatca acagtagcaa aacttatatc aggtttttac 1200

aatgttaata aaggaagcat aaagataggc gggatagcaa taagtgaata ttctgacgaa 1260

gccttaatta aagccatttc ctttgttttt caagattcaa aattattcaa gaagagcatt 1320

tatgataatg tagcgttagc taataaagat gcgacgaaag atgacgttat gagagcctta 1380

aaattagcag gatgcgattt aatattagac aaattcccag aaagagaaaa tacaatcata 1440

ggctcaaaag gtgtttattt atccggtgga gaaaaacaaa gaattgcaat tgctagagca 1500

attttaaagg attccaaaat tattattatg gatgaagcat cagcatctat tgacccagat 1560

aacgagtttg aattgcaaaa agcttttaaa aatcttatga aggataaaac agttatcatg 1620

attgcacaca ggctatctac aattaaagac cttgatgaaa ttattgtcat ggatagtgga 1680

aaaattatag aaagagggtc tgacaaagaa ttaatgtcaa aagatacaag gtataagagc 1740

ctgcaagaga tgtttaacag tgcgaatgaa tggagggttt caaatgaaag agttttataa 1800

<210> 119
<211> 1791
<212> DNA
<213> Streptococcus pneumoniae

<400> 119
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aatttaagta aagcaacact ggcttcattt ttcgtttatt gtataaacat gcttcctgcc 180

atattactta tgatttttgc tcaggaagtt ttggaaaata tgggcaaaag caatggcttt 240

tatatagtat tctcagtttt gattttgata gcaatgtata ttttgctttc tatcgaatac 300

gataaattat ataacacaac ctatcaagaa agtgcagatt taagaataag gacagcggag 360

aatttatcaa aattacctct atcttacttt tctaaacatg acatttccga catttcacaa 420
acaatcatgg ctgatattga aggcatagag catgcaatga gccactcaat accaaaggtg 480
ggcggcatgg tactgttttt cccattaata tctgtaatga tgctagcggg caatgtcaag 540
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tttcaagaaa atatcgaaat gcaaatggag attaaagcat ataatttatc gaaggatatt 720
aaagatgact tatataaaaa aatggaagat agtgagaaag tacacttaaa ggcggaagta 780
actacaattt taactttgtc tatatcttca atatttagct ttatatctct tgctgttgtg 840
atatttgtcg gcgtaaatct aattattaat aaagagataa attctctcta ccttatagga 900
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gaaatatttt atttatcgcc caaaatagaa agattaaaag aaattcaaaa tcaagattta 1020
caagaaggcg atgactatag cttaaaaaaa tttgatattg atctaaaaga tgttgagttt 1080
gcctacaata aagacgcaaa agttttaaat ggtgtaagtt ttaaagctaa gcagggagag 1140
gtcactgctt tggtaggtgc aagtggctgc ggtaaaacaa ctatcttgaa acttatatca 1200
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tcaacagaat cccttttga taaggtgtct attgttttcc aagatgtggt tctctttaat 1320
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gccagagcct tcttaaaaga tgcgccgata ttgatcttag atgagataac agcaagcctt 1560
gatgttaaca acgagaaaaa gattcaagag tctttaaata atttagttaa agataaaact 1620
gttgtaatca tttcacatag aatgaaatcc atagaaaatg cagacaagat agtagttctt 1680
caaaacggaa gagtagaaag cgaaggtaag catgaagagc ttttacaaaa atcaaaaatt 1740
tacaaaaatt taatagaaaa gacaaaaatg gcagaagaat ttatttatta g 1791

<210> 120
<211> 675
<212> DNA
<213> Streptococcus pneumoniae

<400> 120

aaaagacaaa aatggcagaa gaatttattt attaggagga ctacaatgga taataaaaaa 60

ttaaaagtaa aagatttagt aagcatcggt gtttttggcg taatttattt tgccttcatg 120

tttggagttg gtatgatggg cttgattcca atattgttct taatataccc gacagtatta 180

gccatagttg caggaactgt tgttatgtta tttatggcta aggttcaaaa gccatgggca 240

ctatttatat ttggtatgat atcaccactt gtgatgtttg cagctggtca tacctacgta 300

gttgtggttt tatcacttat agtaatgata atagcagaat taattagaaa gattggtaat 360

tataattcat ttaaatacaa tatgctttct tatgcaatct tcagcacatg gatatgtagc 420

tctttaatgc aaatgctttt agcaaaagaa aaatatatgg agtggtcttt gatgactatg 480

ggaaaagatt atgttgatgt attagaaaag ttaataactt atcctcacat ggctttagta 540

gccttaggtg ctttcttagg aggaattctt ggagcatata taggcaaggc tctattgaaa 600

aaacactttt caaatggatt atattgtgtg ggatacttta ctccttgcct aattttatgg 660

tgctatctga attaa 675

<210> 121
<211> 636
<212> DNA
<213> Streptococcus pneumoniae

<400> 121
tgtattagaa aagttaataa cttatcctca catggcttta gtagccttag gtgctttctt 60

aggaggaatt cttggagcat atataggcaa ggctctattg aaaaaacact tttcaaatgg 120

attatattgt gtgggatact ttactccttg cctaatttta tggtgctatc tgaattaaac 180

cctatagtta agatgttttt gagtatacct attgttatta gaatgtttat tttaccattt 240

atggcagcaa gctttatgat aaagacctcg gatgtaggcg caataatttc atcgatggat 300

aagcttaaga tttcaaagaa tgtatccata cctattgcgg ttatgtttag attcttccca 360

tcttttaagg aggagaagaa aaacatcaaa atggctatga gagtaagagg gataaatttt 420

aaaaacccag tcaaatatct tgaatatgtt tctgtgccac tactcattat atcatctaat 480

atatcagatg acattgcaaa agcggcagaa acaaaggcaa tagaaaatcc aattgccaag 540

accagataca ttcgcgtaaa gatacagcta attgattttg tttatgtttt agcggttgct 600

ggacttattg tgggaggctt aatatggttg aaataa 636

<210> 122

<211> 1173
<212> DNA
<213> Streptococcus pneumoniae

<400> 122
ttttgtttat gttttagcgg ttgctggact tattgtggga ggcttaatat ggttgaaata 60

aaaaatttaa gtcttgatta tggtgaagag catatattag atgatatatc actatccata 120

gccgagggag agtgcgtgct atttacagga aaaagtggaa atggtaagtc atctttaata 180

aattcaatca atggactagc tgtaaggtat gataacgcaa agacaaaggg cgaaataatt 240

attgatggta agaatataaa aaatttggaa ctttatcaaa tctcaatgct tgtttcaact 300

gtttttcaaa atcctaagac atattttttt aatgtcaata cgacattaga attattattt 360

tatttggaaa atatcggtct tgcaagagaa gagatggaca ggcgtttgaa ggatatactt 420

gagatattcc cgataaaaaa tcttttgaac agaaatatat ttaatctatc cggcggtgaa 480

aaacaaattc tttgcattgc agcttcttat atagcaggta caaagattat agttatggat 540

gagccttcat cgaatttaga tattaaaagc ataagtgttt tggcaaagat gctaaagata 600

ttaaaagaga aaggcataag cataattgtt gcagagcata gaatttatta tttgatggac 660

atagttgacc gtgtattttt aatagataaa ggaaagctta aaaaaactta tactagaagt 720

gaatttttaa agctagataa aaatgaatta aatgctttaa gtttaagaga taaagaatta 780

agtaaattaa aagttcctta tttaaaagaa ggtggagagt atcagataaa aaatcttagt 840

tacaaattta ctgatgatga gtgtttaagc ttaaaagata tttcgttcaa gcttgggaaa 900

atttatggca taataggatc caacggacga ggaaaatcaa cgcttttaag atgtttaata 960

ggtcttgaga aaaaatcaaa agaagaaatt tattttaagg gagagaagct atctaaaaaa 1020

gaaagactca aaaactcttc acttgttatg caagatgtaa atcatcaatt attcacagat 1080

gaagtattca acgagcttag attaggagta aagaattttg atgaagaaaa ggcgaaaatc 1140

attttaaacc ccaattattc accccaaatc taa 1173

<210> 123
<211> 276
<212> DNA
<213> Streptococcus pneumoniae

<400> 123
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ggagggcaaa agcaaaggct tgcaatagca tctgttatgt gcaagaattc tccatttgtc 120

tttttgacg aaccttcaag tggtatggat tattccaata tgataaaaat atctgaactg 180

attaataagt ataaaaccat ggataaaata atttttattg tttcccatga tatagaattt 240

ttaaatgaag tggcagatga aatttttgaa ttgtaa 276

<210> 124
<211> 975
<212> DNA
<213> Streptococcus pneumoniae

<400> 124
aaaggacgag agagctcaat ggatattaga ccgcaatcaa gtgatgaact tgattcgcaa 60

agaagagtaa ggagagacat gtcaaatagt ttaaaaggga ctttactaac agttgtggct 120

ggtattgctt gggggttgtc aggaacgagt ggccaatacc taatggcaca cggaatttcg 180

gctctggtct tgactaactt gcgtctttta atcgctggtg gaattctcat gctcttggct 240

tatgctactg caaaggataa aatactggtc tttttaaagg atagaaagag tttgctgtct 300

cttcttattt ttgctctgat tggtcttttt ctcaaccaat tcgcctatct gtctgctatt 360

caggagacca atgcgggaac agcgacggtg cttcagtatg tttgtcctgt cggaatttta 420

atttatagct gtatcaagga tagggtggca ccgacactgg gagagatagt ttccatcata 480

ttcgccatcg gaggaacctt cctgatcgca acacatgggc agttggacca gttatccatg 540

acacctgctg gtctgttctg ggtctctttt tctgccttga cttatgctct gtatatcatt 600

ttacccatag ccttgattaa aaagtggggg agcagcttgg tcattggtgt gggaatggtc 660

atagcaggtt tggtcgccct tcctttttaca ggggttctac aggccgatat cccgactagt 720

cttgattttc tccttgcgtt tgcaggcatt atccttatcg ggactgtctt tgcctataca 780

gctttcctta aaggagccag tctgatagga ccggtcaagt caagcttgtt ggcttcaatt 840

gagccaatat cggcgatttt ctttgccttc ttaataatga atgaacaatt ttatcccatt 900

gattttcttg gtatggcaat gatattgttt gctgtaactt tgatttcttt gaaagattta 960

ttcttagaaa aataa 975

<210> 125
<211> 366
<212> DNA
<213> Streptococcus pneumoniae

<400> 125

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cacaggaagc ctacgatttg gaagccatta tgtacaatcc aaaaatcgtc tctcactctg 120

ttcaagatgc tgctcttggc gaaggagaag gttgcctgtc tgttgaccgt aacgtgcctg 180

gctatgttgt tcgccatgcc cgcgttactg ttgactactt tgacaaagat ggagaaaaac 240

accgtatcaa actcaaaggc tacaactcca ttgttgttca gcatgaaatt gaccacatta 300

acggtatcat gttttacgat cgcatcaatg aaaaagaccc atttgcagtt aaagatggtt 360

tactga 366

<210> 126
<211> 261
<212> DNA
<213> Streptococcus pneumoniae

<400> 126
gtttactctt taaaaaagat agaaatgaga gaaatcatgc tactgcaact attttcttta 60

tatttcgaga gtttgatctt gaccaccatc cttgttctga tttttttagg gatttggatt 120

ggtctgagag ccatgtcggg agttgataag acagccaggg ctcgccaagc ccatctctat 180

gatatgatta tgattggagt cttggttgtc ccagtattat cctttgcggt tatgagttta 240

attcttgttt tcaaggcata a 261

<210> 127
<211> 579
<212> DNA
<213> Streptococcus pneumoniae

<400> 127
gatgccagta gatggcgaac gcttggccta tcaaaaatta aagaaataat gcaaaagaag 60

tatgtaaaaa tcctctactc ctcaccaatt ggtattctat cacttgtagc tgatgaccat 120

tatttgtatg gaatttgggt tcaggagcag aagcattttg agaggggact aggagatgaa 180

acgatagaag aagttgttag tcatcctatt ttagacccag ttattgcttg cttagatgat 240

tactttaaag gcaagcctca ggatttatcc aacttgctct tggcgccaat cggaacgaat 300

tttgaaaaga gagtttggga ctatttacag ggcattcctt atggtcagac agtgacctat 360

ggacaaattg ctcaagacct gcaagtggct tctgctcaag caattggtgg agcagtggga 420

cgcaatcctt ggtctatcct agtaccttgt catcgtgtgt tgggagcagg caagcgtctg 480

acaggttatg ctgcaggagt ggaaaagaaa gcttggctct tggagcatga aggagtagat 540

tttaaagata gaagcaatag aaggagaagc acatgttag 579

<210> 128
<211> 1455
<212> DNA
<213> Streptococcus pneumoniae

<400> 128
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aatatgaata aaagtagact aggacgtggc agacacggga aaacgagaca tgtattattg 120

gctttgattg gtattttagc aatttctatt tgcctattag gcggatttat tgcttttaag 180

atctaccagc aaaaaagttt tgagcaaaag attgaatcgc tcaaaaaaga gaaagatgat 240

caattgagtg agggaaatca gaaggagcat tttcgtcagg ggcaagccga agtgattgcc 300

tattatcctc tccaagggga gaaagtgatt tcctctgtta gggagctgat aaatcaagat 360

gttaaggaca agctagaaag taaggacaat cttgttttct actatacaga gcaagaagag 420

tcaggtttaa agggagtcgt taatcgtaat gtgaccaaac aaatctatga tttagttgct 480

tttaagattg aagagactga aaagaccagt ctaggaaagg ttcacttaac agaagatggg 540

caacctttta cacttgacca actgttttca gatgctagta aggctaagga acagctgata 600

aaagagttga cctccttcat agaggataaa aaaatagagc aagaccagag tgagcagatt 660

gtaaaaaact tctctgacca agacttgtct gcatggaatt ttgattacaa ggatagtcag 720

attatccttt atccaagtcc tgtggttgaa aatttagaag agatagcctt gccagtatct 780

gctttctttg atgttatcca atcttcgtac ttactcgaaa aagatgcggc cttgtaccaa 840

tcttactttg ataagaaaca tcaaaaagtt gtcgctctaa cctttgatga tggtccaaat 900

ccagcaacga ccccgcaggt attagagacc ctagctaaat atgatattaa agcgactttc 960

tttgtgcttg ggaaaaatgt ttctgggaat gaggacttgg tgaagaggat aaaatctgaa 1020

ggtcatgttg ttggaaacca tagctggagc catccgattc tctcgcaact ctctcttgat 1080

gaagctaaaa agcagattac tgatactgag gatgtgctaa ctaaagtgct gggttctagt 1140

tctaaactca tgcgtccacc ttatggtgct attacagatg atattcgcaa tagcttggat 1200

ttgagcttta tcatgtggga tgtggatagt ctggactgga agagtaaaaa tgaagcatct 1260

attttgacag aaattcagta tcaagtagct aatggctcta tcgttttgat gcatgatatt 1320

cacagtccga cagtcaatgc cttgccaagg gtcattgagt atttgaaaaa tcaaggttat 1380

acctttgtga ccataccaga gatgctcaat actcgcctaa aagctcatga gctgtactat 1440

agtcgtgatg aataa 1455

<210> 129
<211> 744
<212> DNA
<213> Streptococcus pneumoniae

<400> 129
ctacggtttt tatttgtata tggtagaatc tttttacaaa aatacttggt aatcttgttt 60

attcatgcta taataggaac aattactttt aggaggtgca gtatgtctta tttatttgag 120

atattaccga gtttactgaa tggtgcgagc acgactgtac aggtctttgc actggtcttg 180

ctattttcga ttcccttggg cgttttgatt gcctttgcct tgcaagtcca ttggaagccc 240

ctccattatc tgattaacat ttacatctgg gttatgcgag gaacccctt actcttgcaa 300

ctgattttta tctattatgt gctcccaagt attgggattc gtttagaccg ccttcctgca 360

gctattattg cctttgttct caactatgca gcttactttg cagaaatttt ccgtgggga 420

attgacacta ttccaagagg acagtatgag gccgccaagg tcttgaagtt tagccctttt 480

gacagagtgc gctatattat cttgccccaa gtgaccaaga tcgttcttcc tagtgtcttt 540

aatgaagtta tgagtttggt caaggatact tctttggtct atgctctcgg aatttcagac 600

cttatcttgg ctagtcgaac agctgctaac cgcgatgcta gtctagttcc tatgttcttg 660

gcaggagcca tttatttgat tttgattggg attgtgacaa ttatttccaa aaaagttgag 720

aagaagtata gttattatag atag 744

<210> 130
<211> 717
<212> DNA
<213> Streptococcus pneumoniae

<400> 130
atggaagaaa gtattaatcc aatcatctct attggtcctg ttatcttcaa tctgactatg 60

ttagccatga ctttgttgat tgtgggagtt atttttgtct ttatttattg ggcaagccgc 120

aatatgacct tgaaacccaa aggaaagcaa aatgtacttg agtatgtcta tgactttgtt 180

attggattta cagaacctaa cattggttcg cgctacatga aagattactc actcttttc 240

ctttgtttat tccttttcat ggtgattgcc aataaccttg gcttaatgac aaagcttcaa 300

acgatcgatg ggactaactg gtggagttcg ccaaccgcta atttacagta tgacttaacc 360

ttatcttttc ttgtcatttt gttgacacat atagaaagcg ttcgtcgtcg tggatttaaa 420

aaaagtataa aatcttttat gagtcctgtt tttgtcatac cgatgaatat cttggaagaa 480

tttacaaact tcttatcttt ggctttgcgg atttttggga atatctttgc aggagaggtc 540

atgacgagtt tgttacttct tctttcccac caagctattt attggtatcc agtagccttt 600

ggagctaatt tggcttggac tgcattttct gtctttattt cctgcatcca agcttatgtt 660

tttactcttt tgacatctgt gtatttaggg aataagatta atattgaaga ggaatag 717

<210> 131
<211> 1695
<212> DNA
<213> Streptococcus pneumoniae

<400> 131
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gaagagaaat taagctttaa agagcagatt ctgagagatt tagaaaaagt aaaaggctat 120

gatgaagttc tgaaagaaga tgaggcagta gttcgcactc ctgcaaatga accttcaact 180

gaagaactca tggctgattc cttgtcaacg gtagaggaga ttatgagaaa agctcctacc 240

gtgcctactc acccaagtca aggtgtacca gcttctccag cagatgagat tcaaagagaa 300

actcctggtg ttccaagtca tccaagtcaa gatgtacctt cttctccagc ggaagaaagt 360

ggatcaagac caggtccagg tcctgttaga cctaagaaac ttgaaagaga atacaatgaa 420

accccaacaa gggtagctgt ttcctatacg acggcagaga aaaaagcaga acaagcaggt 480

ccagaaacac ctacgcctgc tacagaaaca gtggatatca tcagagatac atcacgtcgt 540

agccgtagag aaggagcaaa acccgttaag cctaagaaag agaagaagtc acatgtgaaa 600

gcttttgtga tttcattcct tgtattcctt gccttgctct cagcaggtgg ttactttggt 660

taccagtacg tgctagattc cttattacct atcgatgcta attctaagaa atatgtgacg 720

gttggaattc cagaaggttc aaacgttcaa gaaatcggta cgacgcttga aaaagctggt 780

ttggtaaagc atggtctgat ttttagtttt tatgccaagt ataaaaatta taccgacttg 840

aaagcaggtt actacaattt gcaaaagagt atgagtacag aagacttact caaagagttg 900

caaaaaggtg gaacagatga accgcaagaa cctgtacttg cgactttgac aattccagaa 960

ggttatacct tggatcagat tgctcaagct gtgggtcaat tgcaaggtga cttcaaagag 1020

tctttgacag cggaggcttt cttggctaaa gttcaagatg agacgtttat cagtcaagca 1080

gtagcgaaat atcctacttt actggaaagt ttgcctgtaa aagacagcgg tgcgcgttat 1140

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gaaggtgcca agacagaaga tcgtaagctc attgcaggtg tattctacaa tcgtttgaat 1380

cgtgatatgc cacttcaaag taatattgca atcttgtatg cccaaggaaa actggggcaa 1440

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tcaagcatca atcaaactaa gagcgataac ctctactttg tagcagatgt cacagaaggc 1620

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agcaaattaa actaa 1695

<210> 132
<211> 879
<212> DNA
<213> Streptococcus pneumoniae

<400> 132
tcgtcgttta caggaggaaa tttaacaggg caattgactg aaaagattca agaacatgaa 60

ttaattaaga ctaaccaagc agagaaaagt gtacaggatg ttttggataa ttgtattgaa 120

agggtacaaa acaattcact gaaatcagat agggttactt cttttgagac cccgtttgct 180

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gcaggatata tatctgtggg aaccttggtt tcgtttttga tttacctctt tcaattactt 300

aatcctatta gtaatatagc taattttgta actgtttatt ctaggagcaa gggatcttca 360

gttgcactgg agaacttgct tgcagttcct aaagaaaaat ttgagggagg aaaatcggta 420

tcaggacgag ggttgaattt taaccatgtc tattttggtt atgatgaaaa tcgacctgtc 480

ttaaaggata ttacttgttc aattttcaag ggcaaaaaa ttgcttttgt tggaccatct 540

ggatcaggaa aatcaacgat tgtgcgtttg ttagagcggt tttataaacc gctttcagga 600

gatattctaa tggagcaatc aagtatatat gattttaact taaaagaatg gagaagtaaa 660

atcgcttggg tttcacaaaa taatgcagtc ttatctggca gtattcgtga caatctttgt 720

ctcggtttga atcgcttagt aactgatgat gaattgatga aagtgctaga cttagtatca 780

ctaggtgatg agattcgctc catgaaagag ggactagata ctgaagttgg tgaacgcgga 840

cgactcttgt caggggggcg aacgaaagac ttcaaatag 879

<210> 133
<211> 555
<212> DNA
<213> Streptococcus pneumoniae

<400> 133
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ttacttgttc tgtctagtct acttgctttg ttgcttcccc ttatcttaaa ggatttaata 120

gatgggagtt ctattgaaaa tataggctcc aaagtatttc aatcgttttt gatttttatt 180

ggtcaagcct tgttttcttc tattggttac tatctgttta gtcaatcggg tgaaaaaaag 240

atagcaaaaa tcaggaaaaa agtgatagag gggttgattt atgtagagaa atccttcttt 300

gataagagcc aaagtgggga gttgacttct gccattgtca atgacacgag tgtcattcgt 360

gagtttttaa ttacgacttt cccaaatatt attctgagtt tagttatggt acttggttcc 420

attgtagtct tatttagtct tgattggaat ctttctctac ttttattcat cactcttcct 480

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caggaggaaa tttaa 555

<210> 134
<211> 1989
<212> DNA
<213> Streptococcus pneumoniae

<400> 134
aacaaatatt taaagcagga ggttccggaa atgaaaaagt ctaagagcaa atatctaacc 60

ttggcaggtc ttgtcctggg tacaggagtt ttattgagcg cgtgtggaaa ttctagcacg 120

gcgtcaaaaa cctacaacta tgtttattca agtgatccat ctagcttgaa ctatctagca 180

gaaaaccgcg cagcaacatc cgatattgtt gcaaatttgg tagacgggtt attagaaaat 240

gaccaatatg ggaatattat tccatcatta gcagaggatt ggactgtttc tcaggacggt 300

ttgacctata cctacaaact tcgtaaggat gccaagtggt ttacttctga gggagaagaa 360

tatgcgcctg taactgccca ggattttgtg acaggtttgc aatatgcagc tgataaaaaa 420

tcagaagcct tgtatctagt gcaggactct gttgctggtt tggatgacta tatcactggt 480

aaaacaagcg acttttcaac tgtcggtgtc aaggcacttg atgaccaaac ggttcaatat 540
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gttaatgcag atttcctgaa atcaaaaggg gatgattttg ggaaggcgga tccatctagt 660
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tactatgatg gtagcgacca agaatcactg gaacgtaatt ttacagctgg tgcttatact 840
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agttctatca aacaatcaat tgaatctgtt ttaggttctg ataatgtagt gattgacatt 1440
cagcaattaa catcagatga gtttgacagt tcaggctact ttgctcaaac agctgctcag 1500
aaagattatg atttatatca tggcggttgg ggacctgatt atcaagaccc gtcaacctat 1560
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gctaataaag agcaagatcc ggccaaacgt tatgagaaat atgctgatat tcaagcttgg 1740
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agaaccgtac catttgctgc tgcctatggt ttaaccggta caaaaggggt tgaatcatat 1860
aaatacctca aagtacaaga taagattgtc acaacagacg aatatgcaaa agccagagaa 1920
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gtcaaataa 1989

<210> 135

<211> 1647
<212> DNA
<213> Streptococcus pneumoniae

<400> 135
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tacattatcc cttggtacat ctggatgggg gcttatgcag ctaaggcaaa tggtctcttt 180

accatgggtt acaatatcta tgcttggttc ttgttggttt caacagcggg gattccagtt 240

gcggtggcca agcaagttgc caagtataat accatgcgag aagaagagca tagctttgcc 300

ctgattcgga gcttcttagg ctttatgaca ggactaggcc tggtttttgc tttagtcttg 360

tatgtctttg ctccttggct agcagacttg tctggcgtgg gcaaagactt gatcccaatc 420

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ttccaaggga tgaataacct caaaccctat gccatgagcc aaattgctga gcaggtcatt 540

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aagattaaca gtaagcgtct cttggttgat accattaagg aagccattcc ttttatcctg 780

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agctggttta ccaactacag caatgaggac ttggttgtca tgttttctta tttctcagcc 900

aatcctaata aaatcacgat gattttgatt tctgtagggg tttcgattgg gagtgttggt 960

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cgtttgtgga gcttctttta tgtagctctt gtcggtgcca tggggggtgg actttatatg 1560

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<210> 136
<211> 639
<212> DNA
<213> Streptococcus pneumoniae

<400> 136
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tcactacgtc aaggttcttt caaccaccaa atggcgctcg aagctgagaa agcacttgct 180

ggtaaagcgg aagttagcta ccttgattat tcagcccttc ctctcttcag ccaagatttg 240

gaagttccaa cacatccagc tgtagctgct gctcgtgaag cagttctcgt tgcggatgct 300

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gactggctat ctcgtgccct tgacttgtct gatacacgtg gcgtttctgc ccttcaagac 420

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aaagacctct tgccatttat ccgtacacaa ggcgttggtg atttcactgc tgcacgtgtt 540

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gaaaaacaag ctcaagactt ggtcgaagct atcaagtaa 639

<210> 137
<211> 1902
<212> DNA
<213> Streptococcus pneumoniae

<400> 137
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agaattggtt taatcggtgt caatgggact ggcaagacca cccttttgga cgtcctttct 180

ggtgtttctg gatttgatgg ggatgtcagt ccttttttcag ctaaaaatga ttaccagatt 240

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tctagtgaac tcaaggaaat ccagctcatt cgtgagtatg aattgattat gctcgactat 360

agtgaggaca agcaggcgcg tttggaacgt gtcatggcag agatggactc tctccaagct 420

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cggattggga agaaagtcat cgagtttcag gatgtttcct ttgcctatga aaataagccc   1020
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<210> 138
<211> 579
<212> DNA

<213> Streptococcus pneumoniae

<400> 138
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gtagcattgg caaaaacaaa ggaagtcttg aaccaagctg ttgctgattt gtatgtagct 180

cacgttgctt tgcaccaagt gcactggtat atgcatggtc gtggtttcct tgtatggcat 240

ccaaaaatgg atgagtacat ggaagctctt gacggtcaat tggatgaaat cagtgaacgc 300

ttgattacac tcggtggaag cccattctct acattgacag agttccttca aaatagtgaa 360

atcgaagaag aagctggtga ataccgtaat gttgaagaaa gcttggaacg tgttcttgtt 420

atctaccgtt acttgtcaga acttttccaa aaaggtttgg atgtcactga tgaagaaggt 480

gacgatgtga caaacggtat ctttgcaggc gctaaaactg aaacagataa aacaatttgg 540

atgcttgcag ccgaacttgg acaagcacct ggtttgtaa 579

<210> 139
<211> 1083
<212> DNA
<213> Streptococcus pneumoniae

<400> 139
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aggatttgca atagaccgtc agagctgtgg ttgttgtatc tcgcttatgg cattttaggt 180

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gataaacgtg gtctcgcaac aggtttagcg attatggggt ttggttttgc ttctttattg 300

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ttaggagcaa gttactttat tatcatgctc ctagcttcac aattcattaa gcgtccaaat 420

gagcaagagc ttgcaatttt atcttcttca gggaaagaaa aaacagcctc tttgacgcaa 480

ggaatggctg caaatcaggc tctaaaaagc aatcggtttt atatgctttg gattattttc 540

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ggatttggtc gcttgctctg ggcgagtttg tctgactata tcggtcgccc tctaaccttt 720

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gttttatttg tagttgctat gtctattttg atgacttgct atggagctgg tttttctttg 840

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aaaatggctc attcgtacac acaaaccttg ttcgtttttc tcattttata cagtatcgcc 1020

ttggctttgt cttattatct aggtcgttca atcaaaaaag aaagtcaaaa agcgcttaca 1080

tga 1083

<210> 140
<211> 468
<212> DNA
<213> Streptococcus pneumoniae

<400> 140
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tctgtggttc taggttattt cttaaaaatc ccaacaccta caggaattct aactctttta 120

gatgctggtg tcttctttgc ggccttttac tttggtagtc gtgaaggagc ggtagtcgga 180

ggactagcaa gtttcttgat tgacctctta tcaggctacc ctcagtggat gttctttagc 240

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ggccttattt tagcaactat tgccatggta ggaggctacg ccttgggttc tgctttgatg 360

aatggctggg cagcagccct cccagaaatt ctaccgaatt ttatgcaaaa tatggtaggg 420

atgattgtag gatttattct tagtcaaagt atcaagaaga ttaagtaa 468

<210> 141
<211> 684
<212> DNA
<213> Streptococcus pneumoniae

<400> 141
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ttactagatg tgggaagtga ccatgcttat ctgcctatcg agttggttga gagaggccaa 120

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gttgaggctc acggcctaaa ggagaaaatc caagtccgtt tagccaatgg cttggcagct 240

tttgaagaga ctgaccaagt gtctgtcatt accattgctg gcatgggtgg tcgtttgatt 300

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gcagaaagca tcttagaaga agctggaaag ttttatgaga ttttggtggt ggaagcagga 480

caaatgaagc tatcagccag tgatgttcgc tttggtccct tcttgtccaa agaagtcagt 540

ccagtatttg tccaaaaatg gcaaaaagaa gctgagaagc tagagttcgc cctcggacaa 600

atcccagaaa aaaatctgga agaacgtcaa gttctagtag ataagattca agctatcaag 660

gaggtgctcc atgttagcaa gtga 684

<210> 142
<211> 336
<212> DNA
<213> Streptococcus pneumoniae

<400> 142
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attgcccaca cttatattgc acaggaaaaa ttagagaatg ccgcaaaggt agctggacat 120

gtgattcatg ttgagactca ggggacaata ggggtagaaa atgaattgag tcaagagcag 180

attgatgcag cggatgtagt tattttagca gttgatgtta agatttctgg tatggaacgc 240

tttgagggta aaaagattat caaggttcca acagaagtgg cagtcaaatc tcccaataaa 300

ctgattgcta aagctgttga gattgttacg aaataa 336

<210> 143
<211> 777
<212> DNA
<213> Streptococcus pneumoniae

<400> 143
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cgtatcgaaa acctcagtgt ctcctacaaa gaaacgttgg cacttaagga tatttcacta 120

gtgctccatg gaccaacaat taccggcatc attggtccaa acggcgctgg gaaatcaaca 180

ctattaaaag gtatgttggg aattatccca catcaaggtc aggcatttct cgatgacaag 240

gaagttaaaa aatccttaca ccgaattgcc tatgtcgaac aaaaaatcaa tatcgactac 300

aactttccca tcaaggtcaa ggaatgcgtc tcgttaggac tatttccctc tattcctctc 360

tttcgaagtt taaaggctaa acattggaag aaagtgcaag aggcccttga aatcgtcggc 420

ctagctgact acgctgaacg tcaaattagt caactgtctg gaggtcaatt ccagcgggtc 480

ttgattgcca gatgtttggt gcaggaagcc gactatatcc tcttggatga accctttgct 540

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gggaagacgg ttctcatcgt tcaccacgac ctcagcaaga ttccccacta cttcgatcaa 660

gtcttacttg tcaatcgaga agtgattgcc tttggtccaa caaaagaaac ttttaccgaa 720

accaatctaa aagaagctta cggtaatcaa ctctttttca atggaggtga cctatga 777

<210> 144
<211> 897
<212> DNA
<213> Streptococcus pneumoniae

<400> 144
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ggcccagtag caggtgttgc catatcttct gctgggatgg tggatccgga taagggtgag 240

attttctatg ctgggccgca aatccctaac tacgcaggca cccagttcaa aaaggaaatc 300

gaagaaagct ttactattcc ttgtgagatt gaaaatgatg tcaactgtgc aggtcttgct 360

gaggcagtat ctggttcagg caagggagca agtgtgacac tttgcttgac cattggaacc 420

ggtatcggtg gttgcttgat tatggatagg aaagtcttcc atggttttag caattcagcc 480

tgtgaagtcg ggtatatgca tatgcaggat ggagcttttc aagacttggc ttctacaaca 540

gctttagtga aatatgtagc tgaagcccat ggagaagatg ttgatcagtg gaatggccgt 600

agaattttca aagaagccac tgaaggaaac aaaatctgca tggaaggtat tgaccgtatg 660

gttgactatc taggaaaagg tctggcaaat atttgctacg ttgccaatcc agaagtggtt 720

attcttggtg gtggtatcat ggggcaagag gctatcctca aacctaagat ccgtacagcc 780

ttgaaagagg ctttggtacc aagtttagca gaaaaaacac gattagaatt tgcccatcac 840

caaaatacag cagggatgtt gggtgcatat tatcatttta agacaaaaca atcctag 897

<210> 145
<211> 690
<212> DNA
<213> Streptococcus pneumoniae

<400> 145
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gtcttggaca tcgtgacagc caatcttctt tttgtcgtct cttgtttacc catcgtgacg 180

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ctgggtttaa tggagttagg aattgtgttt cttacccttt cagatctcta tcttttctgg 360

ggtcaaacag ctctgccctt ccaattgctg aaagccattt gtttaggtat tctgattttt 420

cttactatcg tgatgctggc tagttaccct atcgcggcac gttatgacct atcttggaaa 480

gaaattcttc aaaaaggatt gatgttggct agttttaact ttccttggtt cttcctcatg 540

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atggagaaaa ttttcgcaaa ataccaatag 690

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<211> 915
<212> DNA
<213> Streptococcus pneumoniae

<400> 146
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<210> 147
<211> 1356
<212> DNA
<213> Streptococcus pneumoniae

<400> 147
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ccaccaacag aattatctgg tgagattaca atgtggcact cctttactca aggaccccgt 180

ttagaaagta ttcaaaaatc agcagatgct ttcatgcaaa agcatccaaa aacgaaaatc 240

aagattgaaa cattttcttg gaatgacttc tatactaaat ggactacagg tttagcaaat 300

ggaaatgtgc cagatatcag tacagctctt cctaaccaag taatggaaat ggtcaactca 360

gatgctttgg ttccgctaaa tgattctatc aagcgtattg gacaagataa atttaacgaa 420

actgccttaa atgaagcaaa aatcggagat gattactact ctgttcctct ttattcacat 480

gcacaagtca tgtgggttag aacagatttg ttaaaagaac ataatattga ggttcctaaa 540

acttgggatc aactctatga agcttctaaa aaattgaaag aagctggagt ttatggcttg 600

tctgttccgt ttggaacaaa tgacttaatg gcaacacgtt tcttgaactt ctacgtacgt 660

agtggtggag gaagcctctt aacaaaagat cttaaagcag acttgacaag ccaacttgct 720

caagatggta ttaaatactg ggttaaattg tataaagaaa tctcacctca agattctttg 780

aactttaatg tccttcaaca agctaccttg ttctatcaag gaaaaacagc atttgacttt 840

aactctggct tccatatcgg aggaattaat gccaacagtc ctcaattgat tgattcgatt 900

gatgcttatc ctattccaaa aatcaaagag tctgataaag accaaggaat tgaaacctca 960

aacattccaa tggttgtttg gaaaaattca aaacatccag aagttgctaa agcattctta 1020

gaagcacttt ataatgaaga agactacgtt aaattccttg attcaactcc agtaggtatg 1080

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tatgaaaatg ggccaagtgt acaagctggt atgttgacta accaacacat tattgaacaa 1260

atgttccaag atatcattac aaatggaaca gatcctatga aagcagcaaa agaagcagaa 1320

aaacaattaa atgatttatt tgaggctgtt cagtag 1356

<210> 148
<211> 2403
<212> DNA
<213> Streptococcus pneumoniae

<400> 148
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caagaacgta agtgtcgtta tagcattagg aaactatcgg taggagcggt ttctatgatt 120

gtaggagcag tggtatttgg aacgtctcct gttttagctc aagaaggggc aagtgagcaa 180

cctctggcaa atgaaactca actttcgggg gagagctcaa ccctaactga tacagaaaag 240

agccagcctt cttcagagac tgaactttct ggcaataagc aagaacaaga aaggaaagat 300

aagcaagaag aaaaaattcc aagagattac tatgcacgag atttggaaaa tgtcgaaaca 360

gtgatagaaa aagaagatgt tgaaaccaat gcttcaaatg gtcagagagt tgatttatca 420

agtgaactag ataaactaaa gaaacttgaa aacgcaacag ttcacatgga gtttaagcca 480

gatgccaagg ccccagcatt ctataatctc ttttctgtgt caagtgctac taaaaaagat 540

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gggaaacagt tttacaataa ttacaacgat gcacccttaa aagttaaacc aggtcagtgg 660

aattctgtga ctttcacagt tgaaaaaccg acagcagaac tacctaaagg ccgagtgcgc 720

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gcggctttaa cagagaaaac ggacatattc gaaagcgggc gtaacggtaa cccaaataaa 1020

gatggaatca agagttatcg tattccagca cttctcaaga cagataaagg aactttgatc 1080

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<211> 636
<212> DNA
<213> Streptococcus pneumoniae

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ggcaagacgg ttcttttaaa gatacttgct ggttatatta agcttgacaa aggaaaagtt 180

cttcaagatg gtaaagttta cggggtaaaa aatcattata ttcaggatgc aggaatttta 240

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tatttttcat ctaaagttac ggaaaaaaga attgcctatt ggattcaata ctatgattta 360

caggaatttg aagacattga ataccgtcat ttatccttag gaacaaagca aaaaatggcc 420

ttgattcaag cctttatttc ctctccttct atactctttc tcgatgaacc tatgaatgct 480

ttggatgaga agagtgtgag gttaaccaaa caggtcattt tatcttacct gaaaaaagaa 540

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gtattagttg tcgaaaatgg acatatacaa atgtaa 636

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<211> 297
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tgctcggcgc caatatcatc taaaatcagg acctcagaca gcttaatctc atccaccaag 240

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<210> 151
<211> 1509
<212> DNA
<213> Streptococcus pneumoniae

<400> 151
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attgtcggcc ttcttgggcc aaacggctca ggaaaaacaa ccctgattaa actaattaat 180

ggcctcttac aaccagatca aggacgtgtc ctcatcaacg acatggaccc aagcccagca 240

accaaggccg ttgtagctta tttgcctgat acgacctatc tcaatgagca aatgaaggtc 300

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catctacttg cagacctggg cattgatgaa aatagtcgtc tcaagaaact atcaaaagaa 420

aacaaagaaa aggttcaact gattttggtt atgagccgtg atgctcgtct ctatgttttg 480

gacgaaccca ttggtggggt ggatccagca gcccgtgctt atatcctcaa taccattatc 540

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ttgctttaa 1509

<210> 152
<211> 1185
<212> DNA
<213> Streptococcus pneumoniae

<400> 152
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aactacatcc ttattgctac aaaagcgatt cttagcatgc catttggtct tggtggtttc 180

ttgattggtg gggttcacca attgatcgtc gtgtcaggtg tgcaccacat cttcaacttg 240

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ctgaaaacac ttgctttccc ggctgctctt tctgccttcc taggtattac agagcctgct 420

atcttcgggg tgaacttgcg cttccgtaaa ccattcttcc tttcattgat tgctggtgca 480

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<210> 153
<211> 792
<212> DNA
<213> Streptococcus pneumoniae

<400> 153
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cactgtgcga ctcgtctacg tgtcatggtc aaagatgaag agaaaatcaa taaagaagtg 180
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acctcttggt aa 792

<210> 154
<211> 651
<212> DNA
<213> Streptococcus pneumoniae

<400> 154
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aagctagatg tgacaaccat tatcgagaat attctaacca aggtcatttc tcttttactg 180

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atgggagccc aaggctttct gtctgatgtc atcaatggct tttcatcct ctttgaacgt 480

caactggatg tgggagatga ggtcgttctg acaaatggac cgattactgt atcgggtaag 540

gttgtcagtg tgggaattcg tacgacacag cttcgtagcg aggagcaagc ccttcacttt 600

gtccctaacc gaaatatcac agttgttagc aatttctcac gcacagacta g 651

<210> 155
<211> 1815
<212> DNA
<213> Streptococcus pneumoniae

<400> 155
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cgcgaagaca tcaaccagtt tagccgtgat tacaagggca atcttcacac ttttgaggat 180

ttcgagaagg cctttgcgga attggaacag atctacattc agatgagcca tattggcaac 240

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<211> 615
<212> DNA
<213> Streptococcus pneumoniae

<400> 156

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agtcgtgtga agtaa 615

<210> 157
<211> 666
<212> DNA
<213> Streptococcus pneumoniae

<400> 157
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<210> 158

<211> 1152
<212> DNA
<213> Streptococcus pneumoniae

<400> 158
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<210> 159
<211> 1788
<212> DNA
<213> Streptococcus pneumoniae

<400> 159
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<210> 160
<211> 2127
<212> DNA
<213> Streptococcus pneumoniae

<400> 160
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tcaaatcaaa cttgctttga caagtataag gagaatcaaa tgggaaaatt tgaacaagaa 180

gccaaagatc tgcttcaggc aatcggaggc aaagaaaatg tgactgccgt aactcactgt 240

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attttgggaa ttgttctcgg aatctgtttg gtatcgcctc agttgctcaa tgcctatgcg 780

gttgcttcaa cgccagcagc tgatatcgcg gcaaactggg tttggaattt tggctatttt 840

actgttaatc gtatcggtta ccaagcccaa gttatcccag ccttgcttgc aggtttgagt 900

ctgtcttatc ttgaaatctt ctggcacaag catatcccag aagtcatttc tatgattttt 960

gtacctttct tgtcattgat tccagccttg atttggctc atactgtttt gggaccaatc 1020

ggttggacaa ttggacaagg actttcatca gttgtcttgg caggtttaac tggtccagtt 1080

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caccatatga ccaatgccat tgatacacaa ttgattgcgg atgctggtgg cactgcccta 1200

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atgcatcgcc atgatgagcg tgaggctcag gtttcacttc ctgcaaccat ttcagcctat 1320

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gatatggatg tcattaaggc tgcaggtctg gtgacagaaa ctcctgttat catcaccaac 2040

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<210> 161
<211> 621
<212> DNA
<213> Streptococcus pneumoniae

<400> 161
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cgctttcaca ttgtacaaca tcttagccgt gctatgagtc gtgtgcatgt ccaaatcatg 120

aatcagtttc atcgaaaatc ccatgaatac aaggctatca agcgctactg gaaactcatt 180

caacaggata gccgtaaact gagtgataag cgattttatc gccctacttt tcgcatgcac 240

ttaacaaata aagaaattct tgacaagatt ttaagctatt cagaagactt gaaacaccac 300

tatcagatct atcaactctt actttttcac tttcagaaca aagaccctga gaaatttttc 360

ggactcattg aggacaatct gaagcaggtt catcctcttt ttcagactgt ctttaaaacc 420

tttctcaaag ataaagaaaa gattatcaac gcccttcaac tacactattc taatgccaaa 480

ctggaagcga ccaataatct catcaaactt atcaagcgca atgcctttgg ttttcgaaac 540

tttgaaaact tcaaaaaacg gatttttatc gctttgaaca tcaaaaaaga aaggacgaaa 600

tttgtccttt ctcgagctta g 621

<210> 162
<211> 1080
<212> DNA
<213> Streptococcus pneumoniae

<400> 162
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gaatttgacg ttcgtgacaa agtattgaca gccattcgcg gcgtttccct tgaactagtc 120

gaaggagaag tattagcctt ggtaggtgag tcaggatcag gtaaatctgt tttgacaaag 180

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attgcgacta tcttccagga cccaatgact agtttggacc ccattaaaac aattggtagt 360

cagattacag aagttattgt aaaacaccaa ggaaaaacag ctaaagaagc gaaagaattg 420

gccattgact acatgaataa ggttggcatt ccagacgcag atagacgttt taatgaatac 480

ccattccaat attctggagg aatgcgtcaa cgtatcgtta ttgctattgc ccttgcctgc 540

cgacctgatg tcttgatctg tgatgagcca acaactgcct tggatgtaac tattcaagct 600

cagattattg atttgctaaa atctttacaa aacgagtatc atttcacaac aatctttatt 660

acccacgacc ttggtgtggt ggcaagtatt gcggataagg tagcggttat gtatgcagga 720

gaaatcgttg agtatggaac ggttgaggaa gtcttctatg accctcgcca tccatataca 780

tggagtctct tgtctagctt gcctcagctt gctgatgata aaggggatct ttactcaatc 840

ccaggaacac ctccgtcact ttatactgac ctgaaagggg atgcttttgc cttgcgttct 900

gactacgcaa tgcagattga cttcgaacaa aaagctcctc aattctcagt atcagagaca 960

cattgggcta aaacttggct tcttcatgag gatgctccga aagtagaaaa accagctgtg 1020

attgcaaatc tccatgataa gatccgtgaa aaaatgggat ttgcccatct ggctgactag 1080

<210> 163
<211> 942
<212> DNA
<213> Streptococcus pneumoniae

<400> 163
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gattttgcct ctgaaactat tgatgcgcca gcatattctt actggaaatc agtgtttaaa 120

caatttatga agaaaaaatc aactgtagtc atgttgggaa tcttggtagc catcattttg 180

ataagtttca tctacccaat gttttctaag tttgatttca atgatgtcag caaggtaaac 240

gactttagtg ttcgttatat caagccaaat gcggagcatt ggttcggtac tgacagtaac 300

ggtaaatcgc tctttgacgg tgtctggttc ggagctcgta actccatcct catttctgtg 360

attgcgacag tgattaactt ggttatcggt gtttttgtcg gtggtatttg ggtatttca 420

aaatcagttg accgtgtcat gatggaagtt tacaacgtca tctcaaacat cccacctctt 480

ttgattgtta ttgtcttgac ttactcaatc ggagctggat tctggaatct gatttttgcc 540

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cgtgacttgg aatacaactt ggcgtcacgt actttgggaa caccaacctt gaagattgtt 660

gccaaaaata tcatgcctca attggtatct gttattgtga caaccatgac tcaaatgctt 720

ccaagcttta tctcatacga agccttcttg tctttcttcg gtcttggatt accgattaca 780

gtgccaagtt tgggtcgttt gatttcggat tattcacaaa acgtaacaac caatgcttac 840

ttgttctgga ttccattgac aacccttgtc ttggtatcct tgtccctttt cgtagttggt 900

caaaacttag cggatgctag tgatccacgt acacatagat ag 942

<210> 164
<211> 1533
<212> DNA
<213> Streptococcus pneumoniae

<400> 164
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accttggttc ctcgaaaatt gattttcaag caggatccta actataataa aattgcgaca 180

acggctgata aacgtgataa ctatgaaaat actgtgtttg agcgtatggg ctacattgag 240

tattacgata ctaaagagtt gcaagaaaag gcaagtagca tggattcttc tgtaacagta 300

gaagcaaatg cgaccaataa agctatttat gaaaagtaca tcaatcaatt aggtcatggt 360

tggactttgg gagaatttac tgaaagtggt caattctatg ctactcgtga aattccaatt 420

tttgaacgtg tttttcactt ctatgctaac ttgattgaca ttgaccatac aaataaaatc 480

caagaccctg aaaatccaga cttgaaacgc taccttcgtt ttgaaaatga tccagctatc 540

ggatggtcat tggtcggttc aggaactaaa cataaatatc tcttgtactt taacagtcag 600

ttcccatttg ttcatcaaaa ctttgtgaac ttgaatttag gtgactctta cccaacctat 660

gctaatacac cagttcttca ggttattact caaggtcaag gacaaaccaa aactgcccaa 720

gttcagttcc caacaggtaa gaaaacgtct tctgtaaata tttactcaag aacctacaag 780

tcacctagtc aggctgactc tcgtgaagta gctagctatg ggaaagatga tccttataca 840

gcgactgaaa gtaattacca atatccatct atgattgtca gctctgctat tactggtttg 900

attggtttgg ttcttgccta tgctcttgcc gtgccacttg gttcagccat ggctcgtttc 960

aagaacactt ggattgatag cctctcaaca ggggctttga ccttcttgct tgctcttcca 1020

acgattgcct tggtttacat cgttcgattg attggatcat ctattgccct tccagattca 1080

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caagactttg ttcgtttcgc tcgtgcaaaa ggtttgtctg aaaaagaaat ttcaaacaaa 1260

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ttgattgact ctgtaaaagc atctaataac tctatggtcg ttggtcttgt cttcatcttt 1440

acatgtattt ctatcttctc acgtcttttg ggagatattt ggatgactat tattgaccca 1500

cgtattaaat tgactgagaa aggaggcaaa taa 1533

<210> 165
<211> 1038
<212> DNA
<213> Streptococcus pneumoniae

<400> 165
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tctgctaagc ggattaatca agttttagat ttgcattctt ctatccaaaa ccctgttcaa 120

gtgcagctga ctgatgaaaa cttcaaaggt caggtcgagt ttaaggatgt gaccttccgc 180

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ggtaagacaa ccattgtcaa tcttttgatg aaattctatg agattgataa gggaagtatt 480

cgcattgatg gtgtggatac caaggctatg acgcgttcag aagtgcatga tgccttttca 540

atggtcttgc aggatacctg gctctttgaa ggaactattc gagacaatct catctataat 600

caaataggga ttagtgatga acgaatgatg gaagctagta aggctgtggg aattcaccac 660

tttattatga ccttgccaga tggctatgat accatcttgg atgacaccgt gaccttgtct 720

gtaagacaaa aacaactatt gactattgct cgtgcccttc ttaaggatgc accgcttttg 780

attttggatg aggcgacttc ttctgttgac acacggacag aggaattgat ccaaaaagcc 840

atggaccgtt tgatggaagg acgcacatcc tttgtcattg cccaccgctt gtcaaccatc 900

cgaaatgcag acttgatctt ggtcatgaaa gatggaaata tcatcgagca aggcaactat 960

gaggaactga tggcgcaagg tggcttctac gctgacttgt acaatagtca atttacagaa 1020

gatgaagcag aagaataa 1038

<210> 166
<211> 873
<212> DNA
<213> Streptococcus pneumoniae

<400> 166
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ctagccattc tctttacttg cttttcggtc tatctagagt tggaagtgcc gacctatatc 120

tcgaaaatta cggatttgct aggtagtcaa gaaactaatt tagatgagtt gtggcagtcg 180

gcaagcatga tgatgggaat gtcctttctt gccttcttgt ccgtagttgc agttggattt 240

tttgcatccc gagtggcggc ttcttatact agtaggctga gaagtgatat ttttaaccga 300

gttttggatt actcgcagac agagattaag aaattttcaa ttcctagcct cttgacgcgt 360

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cgtggttcaa ttatggctat ctgggctatt gggaagattt taggtcattc agaatactgg 480

ctctgggccg tacttgtggc agtgattatc aacgtcctga tgacgaccgt tttgatgacg 540

ctagcctttc caaaacagtc cttgattcag gggctgacag ataaactgaa cagtatcact 600

cgtgagagtt taacaggtat tcgtgtcgtt cgtgcctaca atgcagagga ttatcaaaat 660

gaaaaatttg cagcagtaaa tgatgaattg acccgtttga atttgtttgt caaccgtctt 720

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tggattgggg cctatgtgat taacgacgct gctccgatag cgcgtctgcc tctctttagt 840

gacatgattg ttttcatgtc ttatgccatg tag 873

<210> 167
<211> 1383
<212> DNA
<213> Streptococcus pneumoniae

<400> 167
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tcgctcttaa gcttcacctt tccaattttg ctatcaaata tttttcaaca gctctataac 120

actgctgatg tcttgattgt tggacgattt cttggtcaag aatccttggc tgcagtagga 180

gcgacgacag cgatttttga cctgattgta ggttttacac ttggtgttgg caatggcatg 240

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caatatattt ctatgattgt gacctgtgta ggtgtcagct ttgcttataa tctttttgca 480

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cgtaaaagtg tgccagaact cttgccacag tttaaacatt tcaaatggga caaaagcttg 720

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tag 1383

<210> 168
<211> 636
<212> DNA
<213> Streptococcus pneumoniae

<400> 168
gaagggagag agaagatgaa atcaatgaga atcttatttt tgttagcttt aattcaaatc 60

agtttgagta gctgtttcct atggaaggaa tgcatcttgt cctttaaaca aagtacagct 120

tttttcatcg gaagcatggt tttcgtttca ggaatctgtg ctggagtaaa ttatctttat 180

acccgtaagc aagaagtcca tagtgtccta gccagtaaga agtcggtgaa gctttttac 240

agtatgttac tcttaattaa tttgttagga gctgttcttg ttttgtcaga taacttgttc 300

atcaaaaata cgctgcagca agaattagtt gactttttat tgccatcctt ctttttccta 360

tttgggctag atttgctgat ttttttaccc ttgaaaaaat acgtgcgcga ttttcttgct 420

atgctggaca gaaaaaagac agtgttggtg actattttag caacacttct tttcttaaga 480

aatccaatga ccattgtctc acttctgatt tatattggac tgggcttgtt ttttgcagcc 540

tatcttgtcc caaattcggt taagaaggaa gtttcctttt atggtcatat tttccgagat 600

cttgtattgg tcattgttac gctcattttc ttttag 636

<210> 169
<211> 2154
<212> DNA
<213> Streptococcus pneumoniae

<400> 169
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atatatcaaa tggaaaattc agaatgtgga ttagcatgct gtgccatgat attgaactat 120

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acatttaaaa agttagatag ctttatgtct cgtaaagata ataagaagtc gcctgtttta 480

aagtattttt ttaagtatag gaataagcta gggattttat tttttgtaac agcattattg 540

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<210> 170
<211> 369
<212> DNA
<213> Streptococcus pneumoniae

<400> 170
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ttaaatatac caaacgtatt gagatatgat ttgaatatgt tacaattaga atataaaaat 120

gaacaaagtt gggatagttt catagataat gttaatttaa ttgagttgga agagagaatt 180

caaactacta ttggaattaa acaaataaac acacacaata ttattactat tgcccgagaa 240

gggtactctc aaaattattt acctaacact tcagaaaata catataattc attacaagtc 300

agtttagttg gagtattact actttttata agtatggtaa atattttatg ggctaaaaaa 360

agtaaatga 369

<210> 171
<211> 645
<212> DNA
<213> Streptococcus pneumoniae

<400> 171
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ggtagcggaa aaacaacctt gatgaacatg attgggaaat tagaacctta tgatgggacg 180

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gctttagaac aggtcggcct ggtttatctt gacctagata agcgcatctt tgagttatcg 420

ggcggagaat cgcaacgggt tgccttggca aaaattatct taaagaatcc accctttatt 480

ctggcagatg agccaacagc ttcaatagac ccagcaacct ctcagttgat tatggagatt 540

ttgctatctc ttcgagatga taataggcta atcattatcg caacacataa tccggcaatt 600

tgggagatgg ctgatgaagt gttcacgatg gatcatctga aataa 645

<210> 172
<211> 1041
<212> DNA
<213> Streptococcus pneumoniae

<400> 172
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cgccaagtcc ttaaagtaaa tgacacagaa gataaggaag ctggtgccta tcaattcgtt 180
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gctggtaagg atatcgaact caagtacttt ggagtttatg ttttgaatgt gacggataat 420
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<211> 654
<212> DNA
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<211> 897
<212> DNA
<213> Streptococcus pneumoniae

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<211> 1320
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<210> 178
<211> 2706
<212> DNA
<213> Streptococcus pneumoniae

<400> 178

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<213> Streptococcus pneumoniae

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ggcgcaattg aaaaataa 318

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<211> 1824
<212> DNA
<213> Streptococcus pneumoniae

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<213> Streptococcus pneumoniae

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<211> 768
<212> DNA
<213> Streptococcus pneumoniae

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ggcccatctg gttgtggcaa atcaactttt ctaaaaaccc ttaaccggat gaacgatttg 180

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gtcaaagatg atcttaaaaa gagtgccatg tccttatctg gcggtcagca gcaacgcctt 480

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gccttagacc ctatctccac tttaaaaatt gaagacctca ttcagcaact aaaaaaggat 600

tatacgatta tcattgttac ccataacatg caacaagctt cacgtatttc agataaaact 660

gctttttttct taacaggaga aatttgcgaa tttggagata ccgttgacgt gtttaccaat 720

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<211> 681
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<213> Streptococcus pneumoniae

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gttaacatta ttggaagtgt tctgattcca ggaatcagcc tagcaggcca tatcggtggt 540

gcagttggtg gcgcatttct agcagttatc tttccagtta gaggagaaaa acggatgtat 600

aacaccagcc agagattagg agcggtagtc ttgttcgtag gactcgccat tttgcttttc 660

tacaagggaa tgggattgtg a 681

<210> 185
<211> 789
<212> DNA
<213> Streptococcus pneumoniae

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<210> 186
<211> 1203
<212> DNA
<213> Streptococcus pneumoniae

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<211> 588
<212> DNA
<213> Streptococcus pneumoniae

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<210> 188
<211> 1314
<212> DNA
<213> Streptococcus pneumoniae

<400> 188
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<212> DNA
<213> Streptococcus pneumoniae

<400> 189
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<211> 825
<212> DNA
<213> Streptococcus pneumoniae

<400> 190
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<211> 948
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<213> Streptococcus pneumoniae

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gcagaaggaa cctataatca cgagagaaag gcagttttaa tcactgtcat tacacgtgca 840

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tcggaaaatg ttcatattct aggaagattt gttgagatag ataattag 948

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<211> 282
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<213> Streptococcus pneumoniae

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<213> Streptococcus pneumoniae

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<213> Streptococcus pneumoniae

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<211> 1185
<212> DNA
<213> Streptococcus pneumoniae

<400> 196

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ccaaccttag aagaaacgat tgccttttat aaagagttat tttag 1185

<210> 197
<211> 783
<212> DNA
<213> Streptococcus pneumoniae

<400> 197
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aaaagaattg ccgtaaaaga gctggcagaa atcactttct ccagcacaag taccttacgt 120

cgtgatttaa ttttcttaga aaatcaaggt cttatcaaaa gaaagcacgg atacgtgacc 180

ctgtcctcta tgaacacaat tgaactttct catcaaatac gtgaaggaga aagtactagg 240

caaaaaagac taatcgctag tctcgctaaa gactttattc ggtctggtat gtgtatctat 300

ctagattcta gtactactgt ctacgaactc tgtccctatc tttctgaact tgataatttg 360

attattttta caaatggttt acatactgca caaaccctat ctgaaactgt taaagatagc 420

tccaaaatct ttatcacatc tggcgaggtc aaacatcaat cctgttccgt ggtcaactat 480

gataaggaaa attctttatt agatcatttt aatatcgatt tagcattttg ttcagcaaga 540

ggtattgatg accaatatgt ttatgaagct tctctcagcc aagctatttc aaaaaagaat 600

attattgaca aagcccatga aaccatctta ctgattgata gttctaaatt ttacaagact 660

ggatttttta aaattaatcc cctctccaaa tacacaacct ttatttcaga caccgtgcca 720

gatcaaaaat tattagacgc agtcgaatta tttgatggag aatgggtttc tgatattcaa 780

tga 783

<210> 198
<211> 870
<212> DNA
<213> Streptococcus pneumoniae

<400> 198
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atgagtcttt tctcaccggt attgggaacc ttcctcatct tgcgtcgtca gagtttgatg 180

agtgataccc ttagccacgt ctcactttca ggtgtagcct ttggtctggt tttggggatt 240

tctccaactg tttctactat tgccattgtc ttgattgcgg cggtctttct ggagtatctc 300

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tatctctttg gttcgatcgt gactatcagt gaagaacagg tcatttccct ctttgtcatt 480

gcggcggttg ttttgatttt gacctttctc tttcttcgtc ctatgtatat cttaactttt 540

gacgaagata cggcctttgt ggatggcttg ccagttcgta ccatgtccat tctttttaac 600

atggtgacag gggtggctat tgcccttatg attcctgcag caggagctct tctggtatcg 660

accattatgg tcttgccagc tagtattgcc ctgcgtctgg ggaaaaactt taaatcggtt 720

atgctgcttg ccagtgcgat tggctttttg ggaatggtag caggacttta catttcctac 780

tatgcagaaa cacctgcaag tgcaagtatt accattattt ttgtaactgt ctttatacta 840

atcagtttag taagacgttt tatcaaatag 870

<210> 199
<211> 756
<212> DNA
<213> Streptococcus pneumoniae

<400> 199
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attacggtag aggatttgtc cttctattat gataaggagc ctgttcttga acatatcaat 120

tattgtgttg atagtgggga atttgttacc ttgactgggg aaaatggagc ggctaagacg 180

acgctcatca aggctagtct tggaattctg caaccacgca ttggaaaggt ggctatttca 240

aagacaaata cgcaaggtaa gaaattgaga atagcctatc ttcctcaaca aattgccagt 300

tttaatgctg gttttccaag tacggtctat gaatttgtca agtcgggtcg ctatccgaga 360

aaaggctggt tccgtcgttt gaatgctcat gatgaggagc atatcaaggc tagtctggac 420

tcagttggca tgtgggaaca tcgagacaaa cgcttggggt ctctatctgg gggacaaaag 480

cagcgagcgg taattgcgcg tatgtttgct tctgaccctg atgtgtttat cctagacgag 540

ccgacaacgg ggatggatgc aggaagtaaa aatgaatttt acgaactcat gcaccacagc 600

gcccatcatc atggcaaggc tgttttgatg attacccatg accctgaaga agttaaggat 660

tatgcggatc gcaatattca tctagtccgt aaccaagact cgccatggcg ttgtttcaat 720

gttcatgaga atggccagga ggtgggccat gcttag 756

<210> 200
<211> 1566
<212> DNA
<213> Streptococcus pneumoniae

<400> 200
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tttgctcaga cacagcctag ctatcctgtc tataatgttt tggggcagga acacacttat 120

ggcgatttaa aggctgattc ggatagtttg gctgcagtca ttgaccaact aggcttgcct 180

gagaagtctc ctgtggttgt ttttggtggc caagaatatg aaatgttggc aacctttgta 240

gcgctgacta agtcaggtca tgcctacatt ccaattgata gccattcggc cttggagcga 300

gtttcagcta ttttagaagt agcagagcca agcttgatta ttgccatttc agcctttccc 360

ttggagcagg tttctacacc aatgataaat ctagctcagg ttcaagaagc ctttgcccaa 420

gggaataact atgaaatcac gcatccagtc aagggagatg ataattacta cattatcttt 480

acttctggta cgactggtaa gcctaaggga gtgcagattt cacatgataa tctcctcagc 540
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ggtggtacgc ttttcactct tccttcagtc atcactcagg actttaagca actctttgcg 720
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gacctgacag acatcatgat gtcctatatg atgccatcta aattccttta ccgagacagt 1500
ttgccactaa ctccaaatgg aaagattgac atcaaaggat tgattaacga ggtgaataag 1560
agatga 1566

<210> 201
<211> 450
<212> DNA
<213> Streptococcus pneumoniae

<400> 201
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tccttagtac ataacattat cgaagacgga gatacggaat ccttgattcg taagtatctt 120
cattcaggtg ttatcattaa tggtcaacgt tataaaacac tagttggtac accacaggga 180
ggaaatttat ctcctctctt atccaatatc atgcttaatg aattggacaa ggaattagaa 240
aagaggggac ttcgatttgt gcgctacgca gatgattgtg tgattacggt cggaagcgag 300

gcagcctcta agcgtgtgat gtattcagtc agtcgtttta ttgagaaacg gctaggtttg 360

aaagtaaaca tgaccaagag agttgaaata tctaggtttt gggttctgga aattatcaga 420

tggttggaaa agccgtccac atcaagatag 450

<210> 202
<211> 429
<212> DNA
<213> Streptococcus pneumoniae

<400> 202
gaaaggaata cgcacatgtc aaaactgcta gataagatat tatcacgcga aaatatgctg 60

gaagcctaca atcaagtaaa atccaataaa ggctcagctg ggattgatgg aatgactatc 120

gaagagatgg ataattatct cagacaaaac tggcgcttga ctaaggaact gataaaacag 180

agaaaatata agcctcaacc agttcttaga gttgagatac ctaaaccaga cggaggcatc 240

cgtcaactag gaattccaac agttatggat agaatgattc aacaggccat tgtccaagtc 300

atgagcccca tttgtgaacc ccatttctca gatacgagtt atggtttcag accaaatagg 360

tcatgtgaaa aagccatcat gaagctctta gaatacttaa atgacggcta tgagtggata 420

gtggattag 429

<210> 203
<211> 528
<212> DNA
<213> Streptococcus pneumoniae

<400> 203
tgtagatgtg atagaattag tggggaattc ataatgagac agttgaagcg agttggagta 60

tttttattgc ttcctttctt tgttctaatt gacgcccata ttagccagct tctgggctca 120

tttttccccc atgtacattt ggctagtcat tttctttttc tatttctctt atttgagacg 180

atagaagtat cagagtatct ctacctagtc tattgttttg ttataggctt ggtttatgat 240

gtttactttt tccatctaat agggattaca actctcttat ttatcttatt gggagccttc 300

cttcataaat tgaatagtgt tattttgttg aatcgttgga caagaatgct agctatgatt 360

gtgctgacat tcctgtttga aatgggtagt tatcttttgg cttttatggt agggttgaca 420

gtagatagca tgtcgatttt tatagtctat agcttggtac cgacgatgat tttaaatttt 480

ttatggatta ctgtttttca atttattttt gaaaatatt atctataa 528

<210> 204
<211> 1323
<212> DNA
<213> Streptococcus pneumoniae

<400> 204
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gaaaaatact atccagctgt aaaagaaatg gtttatcgaa ctcgtttggc caacggattg 120

acagttgctc ttttgcctaa aaaggaattt aaagaggttt acgggagtgt cactgtacag 180

tttggttcgg tagatacgtt tgtcacagaa gttgacggag atgtaaaaca atatcctgga 240

ggaattgctc attttcttga acataaatta tttgagagag aagattctag tgatttgatg 300

tcggctttta cgagtctagg tgcagatagt aatgccttta caagctttac aaaaacaaac 360

tatctttttt cagcaacgga ttattttta gaaaatttag atttacttga tgaattggta 420

acatcagcac actttactga agcttccatt ctgacagagc aggatattat tcagcaagaa 480

cgagaaatgt accaagatga tccagattcg tgtttattct tttcaacttt agcgaatttg 540

tatcctggta cacctttagc aactgatata gttggaagtg aggagtccat ttcccaaatc 600

aatctaacta atttgcaaga aaattttaca aagttttaca aacctgtaaa catgtctctg 660

tttttagttg gtaattttga tgtggagcga gtacaggact attttgaaag caaagaactg 720

aaagattcag attttcagga agtagcaaga gaaaagttgt ttttacagcc tgtaaagcca 780

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aaggatttag atattacaga ggaacattta gatattatca aaagagagat gtttggcgaa 1140

tttttcagta gcatgaactc tcttgaattt attgcaacgc aatatgatgc ttttgaaaat 1200

ggtgagataa tttttgattt gccgaaaatt ttacaggaaa ttactttaga ggatgtcctt 1260

gatgctggac atcatttaat agatgatggt gacatagttg attttacaat attcccatcg 1320

tag 1323

<210> 205

<211> 1650
<212> DNA
<213> Streptococcus pneumoniae

<400> 205
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agtgatcgca aactttttga tgatgtcaat atcaaattta cagaaggaaa tacttacgga 120
ttaatcggtg ctaatggtgc cggaaaatca accttttttaa aaattttagc tggagatatc 180
gaacctacta ctggtcacat ctctcttggt ccagatgaac gtctctctgt tcttcgtcaa 240
aatcactttg actacgaaga tgaacgtgcc attgatgtcg ttatcatggg aaatgaaaaa 300
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agccatgacc acgaatttat tcaaactttg gctaaccata tcattgtctt atctaaaaat 1560

ggcgtcattg accgtatcga tgaaacctac gatgaattcc tagaaaatgc agaagtacaa 1620

gcaaaagtta aagaactttg gaaagactaa 1650

<210> 206
<211> 2586
<212> DNA
<213> Streptococcus pneumoniae

<400> 206
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acctatttta tttctttcat cattcctgta gtgattatgt ctggagtata tctatctcaa 120

agtatctact ggaatagcga caactctcct ctattaggag atggctttca tcaatacgtt 180

atttttgatg tagccttacg aaatatccta catggaaata gtaatctgtt ttacaccttt 240

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gcgcctctgg tttacttttt tgatctaacg aatatgccag atgctatcta tctgacaact 360

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gtcagtcaat tagagataaa aacctggcta gatgttttta tcttgattcc tttaattata 540

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aaggggaaag gaactattac actttccttc attcccaatg gttttattac tggagcaatc 2520
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gcataa 2586

<210> 207
<211> 753
<212> DNA
<213> Streptococcus pneumoniae

<400> 207
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gatgaaattt cgaaagaatc gaatattcca atatcataca agacaacggg aaaagtccgt 120

gaatttgaag aatacattga aaatgatgaa gtaaatcagc tttatttcct agatatcgat 180

attcatggaa ttgagaaaaa gggatttgaa gtggctcagc tcattcgtca ttacaatcct 240

tacgctatta tcgtctttat cactagtcga tcagagtttg cgactctaac ctataaatac 300

caggtatcag ccctagattt tgttgataag gatatcaatg atgagatgtt taagaagaga 360

attgagcaaa atatcttcta cacgaagagt atgttacttg aaaatgaaga tgttgtagat 420

tatttcgact acaattacaa gggaaatgat ttaaaaattc cttaccatga tattttgtat 480

attgaaacaa caggggtatc tcataaattg cgcattattg gtaagaattt tgcaaaagag 540

ttttatggta ccatgacaga tattcaggaa aaggacaaac atactcagcg attttattct 600

cctcacaagt catttttggt aaatataggt aatatcagag aaattgatcg aaaaaactta 660

gaaattgttt tctatgaaga ccatcgttgt cctatttcaa gattaaaaat tagaaaatta 720

aaagatattt tagagaaaaa atctcaaaag tga 753

<210> 208
<211> 1338
<212> DNA
<213> Streptococcus pneumoniae

<400> 208
ggagaaagag taatggattt acttggattt gggacagtta ttgttcattt tttaattatt 60

agtcacagtt accgtttaat ttgtaaaggt cgaataaata gaaaagaatt atacgttttt 120

ggtgcttata cattactaac tgaaatagta cttgaatttt ccttttatct tctatattta 180

gataaaatag ggattgaaag atttttattt cctttgggct tatattccta ttttcgatgg 240

atgaaacagt atgagaggga tagaggacta ttcctaagtt tactactatc tcttttatat 300

gagagcactc ataactttct gtccgtaatt ttctcctcta taacaggaga taattttgtt 360

ttacaatatc atttcccatt ctttttcgtt gtgacggtgt taacctattt tgttacatta 420

aaaatcattt actatttcca tttggaacta gcctattttg acaaggacta cctttatcct 480

ttcttgaaaa aagtattttt tgctttacta ttgctacata ttgtatcttt cgtttcagat 540

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attgctttga agcagaagaa atttgaacag aaacatttac agaattacac agatgaaatt 720

gttggtctgt ataatgaaat ccgtggtttt cgacatgatt atgctggaat gcttgtcagc 780

atgcagatgg caattgacag tggtaattta caggaaattg acagaattta caatgaagtt 840

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atagaagact cagctttacg aagtttggtt gctcagtcaa ttgtctatgc tcgaaataat 960

ggtgtagagt ttacactgga agtaaaagat acgattacca agcttccaat tgaactattg 1020

gatttggttc gtatcatgag cgttttattg aataatgctg tcgaaggatc ggctgatagc 1080

tataaaaagc agatggaagt agcagttatt aagatggaaa ctgaaacagt tattgtgatt 1140

cagaattcat gtaaaatgac gatgactcct tcaggagatc tatttgcctt aggattctcc 1200

actaagggaa gaaatcgcgg agtcggatta aataatgtga aagaactact agataagtac 1260

aacaatatta ttttagaaac agagatggaa ggcagtacat ttagacaaat cattagattt 1320

aagagggaat ttgaatga 1338

<210> 209
<211> 375
<212> DNA
<213> Streptococcus pneumoniae

<400> 209
aagaaaatgt ctaaaaatat tgtacaattg aataattctt ttattcaaaa tgaataccaa 60

cgtcgtcgct acctgatgaa agaacgacaa aaacggaatc gttttatggg aggggtattg 120

attttgatta tgctattatt tatcttgcca acttttaatt tagcgcagag ttatcagcaa 180

ttactccaaa gacgtcagca attagcagac ttgcaaactc agtatcaaac tttgagtgat 240

gaaaaggata aggagacagc atttgctacc aagttgaaag atgaagatta tgctgctaaa 300

tatacacgag cgaagtacta ttattctaag tcgagggaaa aagtttatac gattcctgac 360

ttgcttcaaa ggtga 375

<210> 210
<211> 1383
<212> DNA
<213> Streptococcus pneumoniae

<400> 210
agatatagaa agaggtttgt catcgcaaag aaaaaagcga catttgtatg tcaaaattgt 60

gggtataatt cccctaaata tctgggacgt tgccccaact gtgggtcttg gtcttctttt 120

gtggaagagg ttgaggttgc cgaagttaag aatgcgcgtg tgtccttgac aggtgagaaa 180

accaagccca tgaaactagc tgaggtgact tccatcaatg tcaatcgaac caagacggag 240

atggaggaat tcaaccgtgt gcttggaggc ggagtggtac caggaagtct cgtccttatc 300

ggtggggatc ctgggattgg gaaatcaact cttctcctac aagtctcaac ccagttgtcc 360

caagtgggga cagttctcta tgtcagtggg gaggagtctg cccagcagat taaactacgt 420

gcagagcgct taggtgatat tgatagtgag ttttatctct atgcagagac caatatgcag 480

agtgttcgtg cagaagtgga gcgtatccag ccagactttc tcattattga ttccatccag 540

accatcatgt ctcctgagat ttcaggggtg caggggtctg tttctcaggt gcgtgaagtg 600

accgctgaac tcatgcagtt ggccaagacc aataacattg ccatctttat cgtaggtcat 660

gtgaccaaag aaggaacctt ggctgggcct cgtatgttgg agcatatggt ggatacggtg 720

ctttactttg aaggggagcg tcaccacacc tttcgtattt tgagagcggt caaaaatcgt 780

tttggttcca ctaatgagat tgggattttt gagatgcagt cgggcggctt ggttgaggta 840

ctcaatccga gtcaagtttt cctagaagag cgtttggatg gggcgactgg ttcctccatc 900

gttgtaacca tggaagggac gcgtccgatt ttggcggagg ttcaggcttt ggtaacaccg 960

accatgtttg gaaatgccaa gcgtactacg acaggacttg attttaaccg tgctagcttg 1020

attatggctg ttttggaaaa acgggcaggg cttctcttgc aaaatcagga tgcctatctc 1080

aaatctgctg gtggtgttaa attggatgaa cctgcgattg acttggctgt tgcagttgct 1140

attgcttcga gctacaaaga caagccaact aatcctcagg aatgttttgt cggagaactg 1200

ggcttgacag gagagattcg gcgcgtgaat cgtattgagc aacgcatcaa cgaagctgct 1260

aaactgggct ttactaagat ttatgtacct aagaattcct tgacaggaat cactctgcct 1320

aaggaaattc aggtcattgg cgtgacaacg attcaggaag tcttgaaaaa ggtctttgca 1380

taa 1383

<210> 211
<211> 753
<212> DNA
<213> Streptococcus pneumoniae

<400> 211
aaccatctac tatacggacg gttcgaggtc aggtgcggaa tatggactaa tgggagtttc 60

tatctttcta gctctctttt acatgattcc ggctctttat tttctcttcc gtattgggaa 120

aaatgggaat tgccaaagaa ggttttgatt ctgtctttat tgggagggat gttcctttca 180

ggctggttgt ctagttttgc taatacttat atccatgatt tactgggggt tcttttccca 240

gatagtccat ttttaaatgc ctttgaaagt gctattgcgg ctcctttggt agaagaaccc 300

ttgaaattat tgtcacttgt ttttgttttg gctttgattc ctgtgcgaaa attaaaatct 360

ttgtttttac ttggaattgc ttccggtttg ggattccaaa tgattaagga tattggttat 420

attcgtacgg atttgccaga gggctttgac tttactattt cgcgaatttt agagcgtatc 480

atctcaggaa ttgcctctca ctggactttt tcaggtctag ctgtagtagg tgtttacttg 540

ctttacagag cctataaagg acagaaggtt ggcaagaaac agggccttat ttttctaggt 600

ttagccttgg gaactcactt cttgtttaac tctccttttg tggagttgga aacagagttg 660

cctttagcga ttccagtggt tacggctatt gctctctatg gtttttatca tgcttattgc 720

tttgttgaga aacacaatga gttgatgacc tag 753

<210> 212
<211> 2187
<212> DNA
<213> Streptococcus pneumoniae

<400> 212
ttttcattga gtattaggga aaaggagatg aatatgaaat ttgggaaacg tcattatcgt 60

ccgcaggtgg atcagatgga ctgcggtgta gcttcattag ccatggtttt tggctactat 120

ggtagttatt attttttggc tcacttgcga gaattggcta agacgaccat ggatgggacg 180

acggctttgg gcttggtcaa ggtggcagag gagattggtt ttgagacgcg agccattaag 240

gcagatatga cgctttttga cttgccggat ttaacttttc cttttgttgc ccatgtgctt 300

aaggaaggga aattgctcca ctactatgtg gtgactgggc aggataagga tagcattcat 360

attgccgatc cagatcccgg ggtgaagttg actaaactgc cacgtgagcg ttttgaggaa 420

gaatggacag gagtgactct tttatggca cctagtccag actataagcc tcataaggaa 480

caaaaaaatg gtctgctctc ttttatccct atattagtga agcagcgtgg cttgattgcc 540

aatatcgttt tggcaacact cttggtaacc gtgattaaca ttgtgggttc ttattatctg 600

cagtctatca ttgataccta tgtgccagat cagatgcgtt cgacactagg gattatttct 660

attgggctag tcatcgtcta catcttccag caaatcttgt cttacgctca ggagtatctc 720

ttgcttgttt tggggcaacg cttgtcgatt gacgtgattt tgtcctatat caagcatgtt 780

tttcacctcc ctatgtcctt ctttgcgaca cgcaggacag gggagatcgt gtctcgtttt 840

acagatgcta acagtatcat cgatgcgctg gcttcgacca tcctttcgat tttcctagat 900
gtgtcaacgg ttgtcattat ttcccttgtt ctattttcac aaaataccaa tctcttttc 960
atgactttat tggcgcttcc tatctacaca gtgattatct ttgcctttat gaagccgttt 1020
gaaaagatga atcgggatac catggaagcc aatgcggttc tgtcttcttc tatcattgag 1080
gacatcaacg gtattgagac tatcaagtcc ttgaccagtg aaagtcagcg ttaccaaaaa 1140
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cagcaaaagg ctctgaaaaa ggttgcccat ctcttgctta atgtcggcat tctctggatg 1260
gggggctgttc tggtcatgga tggcaagatg agtttggggc agttgattac ctataatacc 1320
ttgctggttt actttactaa tcctttggaa aatatcatca atctgcaaac caagcttcag 1380
acagcgcagg ttgccaataa ccgtctaaat gaagtgtatc tagtagcttc tgagtttgag 1440
gagaagaaaa cagttgagga tttgagcttg atgaagggag atatgacctt caagcaggtt 1500
cattacaagt atggctatgg tcgagatgtc ttatcggata tcaatttaac cgttccccaa 1560
gggtctaagg tggcttttgt ggggatttca gggtcaggta agacgacttt ggccaagatg 1620
atggttaatt tttacgaccc aagtcaaggg gagattagtc tgggtagtgt caatctcaat 1680
cagattgata aaaaagccct gcgccagtac atcaactatc tgtctcaaca gccctatgtc 1740
tttaacggaa cgattttgga gaatcttctt ttgggagcca aggaggggac gacacaggaa 1800
gatatcttac gggcggtcga attggcagag attcgagagg atatcgagcg catgccactg 1860
aattaccaga cagaattgac ttcggatggg gcagggattt caggtggtca acgtcagaga 1920
atcgctttgg cgcgtgctct cttgacagat gcgccggtct tgattttgga tgaggcgact 1980
agcagtttgg atattttgac agagaagcgg attgtcgata atctcattgc tttggacaag 2040
accttgattt tcattgctca ccgcttgact attgctgagc ggacagagaa ggtagttgtc 2100
ttggatcagg gcaagattgt cgaagaagga aagcatgctg atttgcttgc acagggtggc 2160
ttttacgccc atttggtcaa tagctag 2187

<210> 213
<211> 960
<212> DNA
<213> Streptococcus pneumoniae

<400> 213
atggatatca aaataaaaag ggaggaaatt atgaaaaagt tttcaaaaac attgagagac 60

aactggatct ttctcttgat ggttttgcca ggggcactct ggttgattct attcttttac 120

attccagtat ttgggaacgt ggttgccttc aaagactacc acatgaccag taatggtttc 180

atagatagta tcataaatag taaatgggtc ggactcgata atttagatt cttatttagt 240

tcaagagacg cctttattat cacacgaaat actgtcctct acaatcttgg ctttatcttt 300

ctaggtttag ttgtatctgt agggattgcc attatcctca gcgagctccg ttctaagaga 360

atggtgaaga tttttcaaac ttctatgttg ttcccttact tcttgtcttg ggttatcatc 420

agtttcttta cagatgcctt cctaaatatt gataaagggg tgttcaatca tctattggaa 480

agtcttggtc tcaaagaagt caatttctac gctgacctgg gcatctggcc ctatctccta 540

cttttcctag gtatttggaa aggctttgga tatagcagtg tcatgtacta tgcgacgatc 600

atgggaattg atccaaccta ctacgaagca gcgacagtgg acggagctag caagtggcaa 660

cgtattcgca acgtaaccat tcctcagttg actccgcttg taactgtatt gaccatcctt 720

gcagtcggaa atatcttccg cgcagacttc ggtctcttct atcaaatccc acacaatgct 780

ggtcagcttt acaatgtaac caacgttttg gacgtatatg tctttaatgg tttgactcag 840

acagcagata tcggtatggc tgcagcagcc ggtctttacc aatccgttgt tggtttgatt 900

ctggttatcc tatcaaactt gcttgcaaga cgagtcgatc caaactcagc tttgttctag 960

<210> 214
<211> 1179
<212> DNA
<213> Streptococcus pneumoniae

<400> 214
aagaggtatt atatgaaaaa gcaatcactc ttttttgttc caggtattat cctgattggt 60

gtttccttgc gaactccttt tactgtttta cccattattt tgggaaatat ttcgcaaggt 120

ctggaggtag aagttagttc gcttggtgtc ttgaccagcc tgcctctcct tatgtttacc 180

ctcttttcac cattttctac ccaactggct cagaaaatcg gcttggagca tctcttcacc 240

tacagcctct tcttcttgac catcggctca cttattcgac taatcaatct gcccctgctc 300

tatctaggaa ccttgatggt tggggcaagt gtcgcagtca tcaatgtcct gcttcctagt 360

cttatccaag ccaatcaacc aaagaaaatt ggttttctga ccaccttata tgtaacgtct 420

atggggattg caacggctct ggcttcctat ctagctgtgc ccattacaca agccagttct 480

tggaaaggac ttatccttct cctcacgtta ctctgtctag caacttttt ggtctggctc 540

ccaaatcacc gctataatca tagactagct ccacaaacca aacaaaaaag tcaaataaag 600

gtcatgcgta ataaacaggt ttgggcaatt attatctttt caggttttca atccttgatc 660

ttttacaccg tcatgacctg gttacctacc atgtctatcc atgcaggtct atccagtcac 720

gaagctggct tgctgacttc tatcttatct ctgattagca ttcctttttc aatgaccatc 780

ccaagcctga caaccagttt atctactcgc aaccgtcagc tcatgctcac tctggtttca 840

ctagctggtg tggtcggcat ttccatgctc tttttcccaa tcaataattt catttactgg 900

cttgccatcc atctcctcat cggaaccgca accagtgccc tcttccctta tctcatggtc 960

aacttttcac tcaagacaag cgcccctgaa aagacagccc aattgtccgg cctatctcaa 1020

acaggaggct atatcctagc agcctttggg ccaaccctct ttggttacag ttttgacctg 1080

ttccactctt gggtaccatc tgtagctgcc ctcttgctca tcgatatcct gatgactgtg 1140

gccctcttta cagtggacag agcggataag atcctttaa 1179

<210> 215
<211> 453
<212> DNA
<213> Streptococcus pneumoniae

<400> 215
ttggatttcc tctttgctgc tggtgccttt ggactagtca tcgcaaacaa tgcctccatc 60

tcaggtgctg agggtgggtg tcaagctgaa gttggttcag cctctgctat gagtgctgcc 120

gccttgactc tggctgcagg tggaacacct tatcaggcca gtcaagctat tgcctttgtc 180

attaaaaata tgctaggcct catctgtgac cctgttgcag gtttggtcga agttccctgt 240

gtcaaacgta atgccatggg agctagcttt gctttcatcg cagcagacat ggccttggca 300

ggtatcgaat ctaaaatccc tgtggatgaa gtgatcgatg ccatgtacca agtaggagca 360

agcatgccaa ctgcctttcg tgaaacagct gaaggtggac tcgctaccac ccctactggt 420

cgtcgcctcc aaaaagaaat tttcggagaa taa 453

<210> 216
<211> 197
<212> PRT
<213> Streptococcus pneumoniae

<400> 216

Met His Leu Thr His Arg Glu Val Arg Asp Lys Leu Leu Ser Tyr Ser

1 5 10 15

Glu Gly Leu Gln Val His Tyr Glu Leu Tyr Gln Leu Leu Leu Phe His
20 25 30

Phe Gln Glu Lys Asn Ala Asp His Phe Phe Gly Leu Ile Glu Gln Glu
35 40 45

Leu Pro Thr Val His Pro Leu Phe Gln Thr Val Phe Trp Thr Phe Leu
50 55 60

Arg Asp Arg Asp Lys Ile Ile Asn Ala Leu Lys Leu Pro Tyr Ser Asn
65 70 75 80

Ala Lys Leu Glu Ala Thr Asn Asn Leu Ile Lys Ile Ile Lys Arg Lys
85 90 95

Ala Phe Gly Phe Arg Asn Phe Asn Asn Phe Lys Lys Arg Ile Leu Met
100 105 110

Thr Leu Asn Ile Lys Lys Glu Ser Thr Asn Phe Val Leu Ser Arg Leu
115 120 125

Gln Leu Phe Ala Tyr Pro Leu His Leu Thr Lys Ser His Ser Leu Phe
130 135 140

His Gly Ile Lys Gly Lys Thr Trp Phe Gly Ile Glu Val Pro Ala Cys
145 150 155 160

Glu Val Phe Phe Val Pro Leu Ala Asp Ala Gly Ile Gly Asn His Thr
165 170 175

Cys Ile Val Ser Ala Glu Ser Gln Arg Gly Asp Asp Asn Leu Asp Ile
180 185 190

Cys Asp Phe Gly Cys
195

<210> 217
<211> 218
<212> PRT
<213> Streptococcus pneumoniae

<400> 217

Met Pro Thr Ala Leu Gly Tyr Val Ser Ile Gly Leu Ala Cys Gly Ile
1   5   10   15

Ile Gly Ala Pro Tyr Val Thr Pro Val Glu Met Gly Leu Met Ser Leu
            20   25   30

Phe Val Tyr Ala Gly Ser Ala Gln Phe Ala Met Leu Ala Leu Ile Val
        35   40   45

Val Gln Ala Pro Val Ala Ala Ile Ala Met Thr Val Phe Leu Ile Asn
    50   55   60

Leu Arg Leu Phe Leu Leu Ser Leu His Ala Ser Thr Tyr Phe Arg His
65   70   75   80

Thr Ser Leu Trp Tyr Asn Ile Gly Met Ser Ser Ile Leu Thr Asp Glu
                85   90   95

Thr Tyr Gly Val Leu Met Gly Glu Leu Ala His Thr Asp Lys Val Asn
            100   105   110

Pro Met Trp Met His Gly Asn Asn Leu Asn Ser Tyr Val Ala Trp Phe
        115   120   125

Val Gly Thr Val Val Gly Thr Ala Leu Gly Gly Leu Leu Pro Asn Pro
    130   135   140

Glu Ile Phe Gly Leu Asp Phe Ala Leu Val Gly Met Phe Ile Gly Ile
145   150   155   160

Phe Ala Ser Gln Phe Gln Ile Met Gln Arg Arg Ile Pro Val Arg Asn
                165   170   175

Leu Leu Ile Ile Leu Ala Val Val Ala Val Ser Phe Phe Leu Leu Leu
            180   185   190

Thr Val Met Ser Gln Ser Leu Ala Val Leu Phe Ala Thr Leu Leu Gly
        195   200   205

Cys Ser Met Gly Val Val Leu Asp Gly Gln
    210   215

<210> 218
<211> 276
<212> PRT
<213> Streptococcus pneumoniae

<400> 218

Met Lys Lys Ile Val Lys Tyr Ser Ser Leu Ala Ala Leu Ala Leu Val
1   5   10   15

Ala Ala Gly Val Leu Ala Ala Cys Ser Gly Gly Ala Lys Lys Glu Gly
            20   25   30

Glu Ala Ala Ser Lys Lys Glu Ile Ile Val Ala Thr Asn Gly Ser Pro
        35   40   45

Lys Pro Phe Ile Tyr Glu Glu Asn Gly Glu Leu Thr Gly Tyr Glu Ile
    50   55   60

Glu Val Val Arg Ala Ile Phe Lys Asp Ser Asp Lys Tyr Asp Val Lys
65   70   75   80

Phe Glu Lys Thr Glu Trp Ser Gly Val Phe Ala Gly Leu Asp Ala Asp
                85   90   95

Arg Tyr Asn Met Ala Val Asn Asn Leu Ser Tyr Thr Lys Glu Arg Ala
            100   105   110

Glu Lys Tyr Leu Tyr Ala Ala Pro Ile Ala Gln Asn Pro Asn Val Leu
        115   120   125

Val Val Lys Lys Asp Asp Ser Ser Ile Lys Ser Leu Asp Asp Ile Gly
    130   135   140

Gly Lys Ser Thr Glu Val Val Gln Ala Thr Thr Ser Ala Lys Gln Leu
145   150   155   160

Glu Ala Tyr Asn Ala Glu His Thr Asp Asn Pro Thr Ile Leu Asn Tyr
                165   170   175

Thr Lys Ala Asp Leu Gln Gln Ile Met Val Arg Leu Ser Asp Gly Gln
180 185 190

Phe Asp Tyr Lys Ile Phe Asp Lys Ile Gly Val Glu Thr Val Ile Lys
195 200 205

Asn Gln Gly Leu Asp Asn Leu Lys Val Ile Glu Leu Pro Ser Asp Gln
210 215 220

Gln Pro Tyr Val Tyr Pro Leu Leu Ala Gln Gly Gln Asp Glu Leu Lys
225 230 235 240

Ser Phe Val Asp Lys Arg Ile Lys Glu Leu Tyr Lys Asp Gly Thr Leu
245 250 255

Glu Lys Leu Ser Lys Gln Phe Phe Gly Asp Thr Tyr Leu Pro Ala Glu
260 265 270

Ala Asp Ile Lys
275

<210> 219
<211> 457
<212> PRT
<213> Streptococcus pneumoniae

<400> 219

Met Val Phe Pro Ser Glu Gln Glu Gln Ile Glu Lys Phe Glu Lys Asp
1 5 10 15

His Val Ala Gln His Tyr Phe Glu Val Leu Arg Thr Leu Ile Ser Lys
20 25 30

Lys Ser Val Phe Ala Gln Gln Val Gly Leu Lys Glu Val Ala Asn Tyr
35 40 45

Leu Gly Glu Ile Phe Lys Arg Val Gly Ala Glu Val Glu Ile Asp Glu
50 55 60

Ser Tyr Thr Ala Pro Phe Val Met Ala His Phe Lys Ser Ser Arg Pro
65 70 75 80

Asp Ala Lys Thr Leu Ile Phe Tyr Asn His Tyr Asp Thr Val Pro Ala
85 90 95

Asp Gly Asp Gln Val Trp Thr Glu Asp Pro Phe Thr Leu Ser Val Arg
100 105 110

Asn Gly Phe Met Tyr Gly Arg Gly Val Asp Asp Asp Lys Gly His Ile
115 120 125

Thr Ala Arg Leu Ser Ala Leu Arg Lys Tyr Met Gln His His Asp Asp
130 135 140

Leu Pro Val Asn Ile Ser Phe Ile Met Glu Gly Ala Glu Glu Ser Ala
145 150 155 160

Ser Thr Asp Leu Asp Lys Tyr Leu Glu Lys His Ala Asp Lys Leu Arg
165 170 175

Gly Ala Asp Leu Leu Val Trp Glu Gln Gly Thr Lys Asn Ala Leu Glu
180 185 190

Gln Leu Glu Ile Ser Gly Gly Asn Lys Gly Ile Val Thr Phe Asp Ala
195 200 205

Lys Val Lys Ser Ala Asp Val Asp Ile His Ser Ser Tyr Gly Gly Val
210 215 220

Val Glu Ser Ala Pro Trp Tyr Leu Leu Gln Ala Leu Gln Ser Leu Arg
225 230 235 240

Ala Ala Asp Gly Arg Ile Leu Val Glu Gly Leu Tyr Glu Glu Val Gln
245 250 255

Glu Pro Asn Glu Arg Glu Met Ala Leu Leu Glu Thr Tyr Gly Gln Arg
260 265 270

Asn Pro Glu Glu Val Ser Arg Ile Tyr Gly Leu Glu Leu Pro Leu Leu
275 280 285

Gln Glu Glu Arg Met Ala Phe Leu Lys Arg Phe Phe Phe Asp Pro Ala
290 295 300

Leu Asn Ile Glu Gly Ile Gln Ser Gly Tyr Gln Gly Gln Gly Val Lys
305 310 315 320

Thr Ile Leu Pro Ala Glu Ala Ser Ala Lys Leu Glu Val Arg Leu Val
325 330 335

Pro Gly Leu Glu Pro His Asp Val Leu Glu Lys Ile Arg Lys Gln Leu
340 345 350

Asp Lys Asn Gly Phe Asp Lys Val Glu Leu Tyr Tyr Thr Leu Gly Glu
355 360 365

Met Ser Tyr Arg Ser Asp Met Ser Ala Pro Ala Ile Leu Asn Val Ile
370 375 380

Glu Leu Ala Lys Lys Phe Tyr Pro Gln Gly Val Ser Val Leu Pro Thr
385 390 395 400

Thr Ala Gly Thr Gly Pro Met His Thr Val Phe Asp Ala Leu Glu Val
405 410 415

Pro Met Val Ala Phe Gly Leu Gly Asn Ala Asn Ser Arg Asp His Gly
420 425 430

Gly Asp Glu Asn Val Arg Ile Ala Asp Tyr Tyr Thr His Ile Glu Leu
435 440 445

Val Glu Glu Leu Ile Arg Ser Tyr Glu
450 455

<210> 220
<211> 204
<212> PRT
<213> Streptococcus pneumoniae

<400> 220

Met Gly Arg Phe Leu Asp Phe Val Phe Asn Arg Phe Phe Leu Gly Met
1 5 10 15

Ile Ala Thr Ala Phe Phe Trp Leu Leu Thr Leu Ala Gly Gly Ile Ile
20 25 30

Leu Gly Leu Ala Pro Ala Ser Ala Thr Leu Met Ser Leu Tyr Ala Glu
35 40 45

His Gly Tyr Ser Phe Arg Glu Tyr Ser Leu Lys Glu Ala Trp Ser Leu
50 55 60

Tyr Lys Gln Asn Phe Val Ser Ser Asn Leu Ile Phe Tyr Ser Phe Leu
65 70 75 80

Gly Val Gly Leu Val Leu Thr Tyr Gly Leu Tyr Leu Leu Val Gln Leu
85 90 95

Pro His Gln Thr Ile Val His Leu Ile Ala Thr Leu Leu Asn Val Leu
100 105 110

Val Val Ala Leu Ile Phe Leu Ala Tyr Thr Val Ser Leu Lys Leu Gln
115 120 125

Val Tyr Phe Ala Leu Ser Tyr Arg Asn Ser Leu Lys Leu Ser Leu Ile
130 135 140

Gly Ile Phe Met Ser Leu Ala Ala Val Ala Lys Val Leu Leu Gly Thr
145 150 155 160

Val Leu Leu Val Ala Ile Gly Tyr Tyr Met Pro Ala Leu Leu Phe Phe
165 170 175

Val Gly Ile Gly Met Trp His Phe Phe Ile Ser Asp Met Leu Glu Pro
180 185 190

Val Tyr Glu Ile Ile His Glu Lys Leu Ala Thr Lys
195 200

<210> 221
<211> 152
<212> PRT
<213> Streptococcus pneumoniae

<400> 221

Met Lys Lys Gln Val Phe His Asp Ala Ala Thr Gly Val Leu Ile Gly
1 5 10 15

Leu Ile Leu Ser Ile Leu Phe Ser Leu Ile Tyr Ala Pro Asn Thr Tyr
20 25 30

Ala Pro Leu Asn Pro Tyr Ser Leu Ile Gly Gln Val Met Asp Gln His
35 40 45

Gln Val His Gly Ala Leu Val Leu Leu Tyr Cys Thr Leu Ile Trp Ala
50 55 60

Thr Ile Gly Met Leu Phe Asn Phe Gly Asn Arg Leu Phe Ser Arg Asp
65 70 75 80

Trp Ser Met Leu Arg Ala Thr Leu Thr His Phe Phe Leu Met Leu Ala
85 90 95

Gly Phe Val Pro Leu Ala Thr Leu Ala Gly Trp Phe Pro Phe His Trp
100 105 110

Ile Phe Tyr Leu Gln Leu Ile Ile Glu Phe Ala Ile Val Tyr Leu Ile
115 120 125

Ile Trp Ala Ile Leu Tyr Lys Arg Glu Ala Lys Lys Val Asp His Ile
130 135 140

Asn Gln Leu Leu Glu His Arg Lys
145 150

<210> 222
<211> 197
<212> PRT
<213> Streptococcus pneumoniae

<400> 222

Met Tyr Ala Tyr Leu Lys Gly Ile Ile Thr Lys Ile Thr Ala Lys Tyr
1 5 10 15

Ile Val Leu Glu Thr Asn Gly Ile Gly Tyr Ile Leu His Val Ala Asn
20 25 30

Pro Tyr Ala Tyr Ser Gly Gln Val Asn Gln Glu Ala Gln Ile Tyr Val
35 40 45

His Gln Val Val Arg Glu Asp Ala His Leu Leu Tyr Gly Phe Arg Ser
    50   55   60

Glu Asp Glu Lys Lys Leu Phe Leu Ser Leu Ile Ser Val Ser Gly Ile
65   70   75   80

Gly Pro Val Ser Ala Leu Ala Ile Ile Ala Ala Asp Asp Asn Ala Gly
                85   90   95

Leu Val Gln Ala Ile Glu Thr Lys Asn Ile Thr Tyr Leu Thr Lys Phe
            100   105   110

Pro Lys Ile Gly Lys Lys Thr Ala Gln Gln Met Val Leu Asp Leu Glu
        115   120   125

Gly Lys Val Val Val Ala Gly Asp Asp Leu Pro Ala Lys Val Ala Val
    130   135   140

Gln Ala Ser Ala Glu Asn Gln Glu Leu Glu Glu Ala Met Glu Ala Met
145   150   155   160

Leu Ala Leu Gly Tyr Lys Ala Thr Glu Leu Lys Lys Ile Lys Lys Phe
                165   170   175

Phe Glu Gly Thr Thr Asp Thr Ala Glu Asn Tyr Ile Lys Ser Ala Leu
            180   185   190

Lys Met Leu Val Lys
        195

<210> 223
<211> 189
<212> PRT
<213> Streptococcus pneumoniae

<400> 223

Met Lys Lys Ile Val Leu Val Ser Leu Ala Phe Leu Phe Val Leu Val
1   5   10   15

Gly Cys Gly Gln Lys Lys Glu Thr Gly Pro Ala Thr Lys Thr Glu Lys
            20   25   30

Asp Thr Leu Gln Ser Ala Leu Pro Val Ile Glu Asn Ala Glu Lys Asn
35 40 45

Thr Val Val Thr Lys Thr Leu Val Leu Pro Lys Ser Asp Asp Gly Ser
50 55 60

Gln Gln Thr Gln Thr Ile Thr Tyr Lys Asp Lys Thr Phe Leu Ser Leu
65 70 75 80

Ala Ile Gln Gln Lys Arg Pro Val Ser Asp Glu Leu Lys Thr Tyr Ile
85 90 95

Asp Gln His Gly Val Glu Glu Thr Gln Lys Ala Leu Leu Glu Ala Glu
100 105 110

Glu Lys Asp Lys Ser Ile Ile Glu Ala Arg Lys Leu Ala Gly Phe Lys
115 120 125

Leu Glu Thr Lys Leu Leu Ser Ala Thr Glu Leu Gln Thr Thr Thr Ser
130 135 140

Phe Asp Phe Gln Val Leu Asp Val Lys Lys Ala Ser Gln Leu Glu His
145 150 155 160

Leu Lys Asn Ile Gly Leu Glu Asn Leu Leu Lys Asn Glu Pro Ser Lys
165 170 175

Tyr Ile Ser Asp Arg Leu Ala Asn Gly Ala Thr Glu Gln
180 185

<210> 224
<211> 152
<212> PRT
<213> Streptococcus pneumoniae

<400> 224

Met Lys Leu Lys Arg Phe Thr Leu Ser Leu Ala Ser Leu Ala Ser Phe
1 5 10 15

Ser Leu Leu Val Ala Cys Ser Gln Arg Ala Gln Gln Val Gln Gln Pro
20 25 30

Val Ala Gln Gln Gln Val Gln Gln Pro Ala Gln Gln Asn Thr Asn Thr
35 40 45

Ala Asn Ala Gly Gly Asn Gln Asn Gln Ala Ala Pro Val Gln Asn Gln
50 55 60

Pro Val Ala Gln Pro Thr Asp Ile Asp Gly Thr Tyr Thr Gly Gln Asp
65 70 75 80

Asp Gly Asp Arg Ile Thr Leu Val Val Thr Gly Thr Thr Gly Thr Trp
85 90 95

Thr Glu Leu Glu Ser Asp Gly Asp Gln Lys Val Lys Gln Val Thr Leu
100 105 110

Asp Ser Ala Asn Gln Arg Met Ile Ile Gly Asp Asp Val Lys Ile Tyr
115 120 125

Thr Val Asn Gly Asn Gln Ile Val Val Asp Asp Met Asp Arg Asp Pro
130 135 140

Ser Asp Gln Ile Val Leu Thr Lys
145 150

<210> 225
<211> 510
<212> PRT
<213> Streptococcus pneumoniae

<400> 225

Met Lys Tyr Arg Lys Phe Gln Leu Leu Met Ser Lys Tyr Gly Phe Ser
1 5 10 15

Leu Ser Ile Met Leu Leu Glu Leu Cys Leu Val Phe Gly Leu Phe Leu
20 25 30

Tyr Leu Gly Arg Met Ala Pro Ile Leu Trp Ile Thr Val Leu Ile Leu
35 40 45

Leu Ser Ile Ile Thr Ile Ile Ser Ile Val Asn Arg Asn Thr Thr Pro
50 55 60

Glu Asn Lys Val Thr Trp Leu Leu Val Ala Phe Val Pro Val Phe Gly
65 70 75 80

Pro Leu Leu Tyr Leu Met Phe Gly Glu Arg Arg Leu Ser Lys Lys Glu
85 90 95

Ile Lys Gln Leu Lys Lys Leu Gly Ser Met His Phe Gln Glu Ala Asn
100 105 110

Ser Gln Leu Leu Lys Glu Lys Leu Lys Glu Ser Asp Lys Ala Ala Tyr
115 120 125

Gly Val Ile Lys Ser Leu Leu Ser Met Asp Thr Asn Ala Asp Ile Tyr
130 135 140

Asp Gln Thr Ala Ser Thr Phe Phe Pro Asn Gly Glu Ala Met Trp Lys
145 150 155 160

Lys Met Val Glu Asp Leu Lys Lys Ala Glu Lys Phe Ile Phe Leu Glu
165 170 175

Tyr Tyr Ile Ile Glu Glu Gly Leu Met Trp Asn Arg Ile Leu Asp Ile
180 185 190

Leu Glu Gln Lys Val Ala Gln Gly Val Glu Val Lys Met Leu Tyr Asp
195 200 205

Asp Ile Gly Cys Met Ala Thr Leu Thr Gly Asp Tyr Ala His Arg Leu
210 215 220

Arg Gln Leu Gly Ile Glu Ala His Lys Phe Asn Lys Val Ile Pro Arg
225 230 235 240

Leu Thr Val Ala Tyr Asn Asn Arg Asp His Arg Lys Ile Leu Ile Val
245 250 255

Asp Gly Gln Ile Ala Tyr Thr Gly Gly Val Asn Leu Ala Asp Glu Tyr
260 265 270

Ile Asn His Val Glu Arg Phe Gly Tyr Trp Lys Asp Ser Gly Ile Arg
275 280 285

Leu Asp Gly Leu Ala Val Lys Ala Leu Thr Arg Leu Phe Leu Thr Thr
290 295 300

Trp Tyr Ile Asn Arg Gly Glu Ile Ser Asp Phe Asp Gln Tyr His Leu
305 310 315 320

Glu Asn His Ser Ile Pro Ser Asp Gly Leu Thr Ile Pro Tyr Gly Ser
325 330 335

Gly Pro Lys Pro Ile Phe Arg Ala Gln Val Gly Lys Lys Val Tyr Gln
340 345 350

Ser Leu Ile Asn Gln Ala Thr Glu Ser Val Tyr Ile Thr Thr Pro Tyr
355 360 365

Leu Ile Ile Asp Tyr Asp Leu Thr Glu Thr Ile Lys Asn Ala Ala Met
370 375 380

Arg Gly Val Asp Val Arg Ile Ile Thr Pro Tyr Ile Pro Asp Lys Lys
385 390 395 400

Phe Ile Gln Leu Val Thr Arg Gly Ala Tyr Pro Asp Leu Leu Ser Ala
405 410 415

Gly Val Arg Ile Tyr Glu Tyr Ser Pro Gly Phe Ile His Ser Lys Gln
420 425 430

Met Leu Val Asp Glu Asp Phe Ala Val Val Gly Thr Ile Asn Leu Asp
435 440 445

Tyr Arg Ser Leu Val His His Tyr Glu Asn Ala Val Leu Leu Tyr Lys
450 455 460

Thr Pro Ser Ile Arg Glu Ile Ala Arg Asp Phe Arg Asn Ile Phe Ala
465 470 475 480

Asp Ser Gln Glu Val Tyr Pro His Ser Ile Lys Thr Ser Trp Tyr Gln
485 490 495

Lys Leu Val Lys Glu Ile Ala Gln Leu Phe Ala Pro Ile Leu

500 505 510

<210> 226
<211> 81
<212> PRT
<213> Streptococcus pneumoniae

<400> 226

Met Asn Gln Thr Phe Gly Thr Val Val Ser Asn Asp Trp Phe Ser Leu
1 5 10 15

Ser Asn Ile Asn Ile Gln Thr Thr Phe Tyr Cys Leu Arg Leu Ile Ile
20 25 30

Phe Thr Leu Val Val Ile Phe Phe Phe Ile Val Asn Trp Trp Val Lys
35 40 45

Asp Leu Val Glu Ser Phe Ser Ser Tyr Ala Val Asp Asp Thr Pro Thr
50 55 60

Gln Thr Phe Gln Lys Ala Val Arg Val His Phe Asn Ile Asp Asn Thr
65 70 75 80

Phe

<210> 227
<211> 490
<212> PRT
<213> Streptococcus pneumoniae

<400> 227

Met Ile Asn Asp Ile Ile Leu Leu Leu Phe Val Lys Ile Lys Arg Arg
1 5 10 15

Leu Met Met Asp Lys Leu Phe Lys Leu Lys Glu Asn Gly Thr Asp Val
20 25 30

Arg Thr Glu Val Leu Ala Gly Leu Thr Thr Phe Phe Ala Met Ser Tyr
35 40 45

Ile Leu Phe Val Asn Pro Gln Ile Leu Ser Gln Thr Gly Met Pro Ala
50 55 60

Gln Gly Val Phe Leu Ala Thr Ile Ile Gly Ala Val Ala Gly Thr Leu
65 70 75 80

Met Met Ala Phe Tyr Ala Asn Leu Pro Tyr Ala Gln Ala Pro Gly Met
85 90 95

Gly Leu Asn Ala Phe Phe Thr Phe Thr Val Val Phe Gly Leu Gly Tyr
100 105 110

Ser Trp Gln Glu Ala Leu Ala Met Val Phe Ile Cys Gly Ile Ile Ser
115 120 125

Leu Ile Ile Thr Leu Thr Asn Val Arg Lys Met Ile Ile Glu Ser Ile
130 135 140

Pro Asn Ala Leu Arg Ser Ala Ile Ser Ala Gly Ile Gly Val Phe Leu
145 150 155 160

Ala Tyr Val Gly Ile Lys Asn Ala Gly Leu Leu Lys Phe Thr Ile Asp
165 170 175

Pro Gly Asn Tyr Thr Val Val Gly Glu Gly Ala Asp Lys Ala Gln Ala
180 185 190

Thr Ile Ala Ala Asn Ser Ser Ala Val Pro Gly Leu Val Ser Phe Asn
195 200 205

Asn Pro Ala Val Leu Val Ala Leu Ala Gly Leu Ala Ile Thr Ile Phe
210 215 220

Phe Val Ile Lys Gly Ile Lys Gly Gly Ile Ile Leu Ser Ile Leu Thr
225 230 235 240

Thr Thr Val Leu Ala Ile Ala Val Gly Leu Val Asp Leu Ser Ser Ile
245 250 255

Asp Phe Ala Asn Asn His Val Gly Ala Ala Phe Glu Asp Leu Lys Thr
260 265 270

Ile Phe Gly Ala Ala Leu Gly Ser Glu Gly Leu Gly Ala Leu Val Ser

275 280 285

Asp Thr Ala Arg Leu Pro Glu Thr Leu Met Ala Ile Leu Ala Phe Ser
290 295 300

Leu Thr Asp Ile Phe Asp Thr Ile Gly Thr Leu Ile Gly Thr Gly Glu
305 310 315 320

Lys Val Gly Ile Val Ala Thr Asn Gly Glu Asn His Gln Ser Ala Lys
325 330 335

Leu Asp Lys Ala Leu Tyr Ser Asp Leu Ile Gly Thr Thr Val Gly Ala
340 345 350

Ile Ala Gly Thr Ser Asn Val Thr Thr Tyr Val Glu Ser Ala Ala Gly
355 360 365

Ile Gly Ala Gly Gly Arg Thr Gly Leu Thr Ala Leu Val Val Ala Ile
370 375 380

Cys Phe Ala Ile Ser Ser Phe Phe Ser Pro Leu Leu Ala Ile Val Pro
385 390 395 400

Thr Ala Ala Thr Ala Pro Ile Leu Ile Ile Val Gly Ile Met Met Leu
405 410 415

Gly Ser Leu Lys Asn Ile His Trp Asp Asp Met Ser Glu Ala Val Pro
420 425 430

Ala Phe Phe Thr Ser Ile Phe Met Gly Phe Ser Tyr Ser Ile Thr Gln
435 440 445

Gly Ile Ala Val Gly Phe Leu Thr Tyr Thr Leu Thr Lys Leu Val Lys
450 455 460

Gly Gln Val Lys Asp Val His Val Met Ile Trp Ile Leu Asp Ala Leu
465 470 475 480

Phe Ile Leu Asn Tyr Ile Ser Met Ala Leu
485 490

<210> 228
<211> 1077
<212> PRT
<213> Streptococcus pneumoniae

<400> 228

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Met Ile Leu Gln Tyr Val Tyr Trp Ser Val Tyr Met Gln Thr Lys Thr
1               5                   10                  15

Lys Lys Leu Ile Val Ser Leu Ser Ser Leu Val Leu Ser Gly Phe Leu
            20                  25                  30

Leu Asn His Tyr Met Thr Ile Gly Ala Glu Glu Thr Thr Thr Asn Thr
        35                  40                  45

Ile Gln Gln Ser Gln Lys Glu Val Gln Tyr Gln Gln Arg Asp Thr Lys
    50                  55                  60

Asn Leu Val Glu Asn Gly Asp Phe Gly Gln Thr Glu Asp Gly Ser Ser
65                  70                  75                  80

Pro Trp Thr Gly Ser Lys Ala Gln Gly Trp Ser Ala Trp Val Asp Gln
                85                  90                  95

Lys Asn Ser Ala Asp Ala Ser Thr Arg Val Ile Glu Ala Lys Asp Gly
            100                 105                 110

Ala Ile Thr Ile Ser Ser His Glu Lys Leu Arg Ala Ala Leu His Arg
        115                 120                 125

Met Val Pro Ile Glu Ala Lys Lys Lys Tyr Lys Leu Arg Phe Lys Ile
    130                 135                 140

Lys Thr Asp Asn Lys Ile Gly Ile Ala Lys Val Arg Ile Ile Glu Glu
145                 150                 155                 160

Ser Gly Lys Asp Lys Arg Leu Trp Asn Ser Ala Thr Thr Ser Gly Thr
                165                 170                 175

Lys Asp Trp Gln Thr Ile Glu Ala Asp Tyr Ser Pro Thr Leu Asp Val
            180                 185                 190
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Asp Lys Ile Lys Leu Glu Leu Phe Tyr Glu Thr Gly Thr Gly Thr Val
195 200 205

Ser Phe Lys Asp Ile Glu Leu Val Glu Val Ala Asp Gln Leu Ser Glu
210 215 220

Asp Ser Gln Thr Asp Lys Gln Leu Glu Glu Lys Ile Asp Leu Pro Ile
225 230 235 240

Gly Lys Lys His Val Phe Ser Leu Ala Asp Tyr Thr Tyr Lys Val Glu
245 250 255

Asn Pro Asp Val Ala Ser Val Lys Asn Gly Ile Leu Glu Pro Leu Lys
260 265 270

Glu Gly Thr Thr Asn Val Ile Val Ser Lys Asp Gly Lys Glu Val Lys
275 280 285

Lys Ile Pro Leu Lys Ile Leu Ala Ser Val Lys Asp Ala Tyr Thr Asp
290 295 300

Arg Leu Asp Asp Trp Asn Gly Ile Ile Ala Gly Asn Gln Tyr Tyr Asp
305 310 315 320

Ser Lys Asn Glu Gln Met Ala Lys Leu Asn Gln Glu Leu Glu Gly Lys
325 330 335

Val Ala Asp Ser Leu Ser Ser Ile Ser Ser Gln Ala Asp Arg Thr Tyr
340 345 350

Leu Trp Glu Lys Phe Ser Asn Tyr Lys Thr Ser Ala Asn Leu Thr Ala
355 360 365

Thr Tyr Arg Lys Leu Glu Glu Met Ala Lys Gln Val Thr Asn Pro Ser
370 375 380

Ser Arg Tyr Tyr Gln Asp Glu Thr Val Val Arg Thr Val Arg Asp Ser
385 390 395 400

Met Glu Trp Met His Lys His Val Tyr Asn Ser Glu Lys Ser Ile Val
405 410 415

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Gly Asn Trp Trp Asp Tyr Glu Ile Gly Thr Pro Arg Ala Ile Asn Asn
            420                 425                 430

Thr Leu Ser Leu Met Lys Glu Tyr Phe Ser Asp Glu Glu Ile Lys Lys
        435                 440                 445

Tyr Thr Asp Val Ile Glu Lys Phe Val Pro Asp Pro Glu His Phe Arg
    450                 455                 460

Lys Thr Thr Asp Asn Pro Phe Lys Ala Leu Gly Gly Asn Leu Val Asp
465                 470                 475                 480

Met Gly Arg Val Lys Val Ile Ala Gly Leu Leu Arg Lys Asp Asp Gln
                485                 490                 495

Glu Ile Ser Ser Thr Ile Arg Ser Ile Glu Gln Val Phe Lys Leu Val
            500                 505                 510

Asp Gln Gly Glu Gly Phe Tyr Gln Asp Gly Ser Tyr Ile Asp His Thr
        515                 520                 525

Asn Val Ala Tyr Thr Gly Ala Tyr Gly Asn Val Leu Ile Asp Gly Leu
    530                 535                 540

Ser Gln Leu Leu Pro Val Ile Gln Lys Thr Lys Asn Pro Ile Asp Lys
545                 550                 555                 560

Asp Lys Met Gln Thr Met Tyr His Trp Ile Asp Lys Ser Phe Ala Pro
                565                 570                 575

Leu Leu Val Asn Gly Glu Leu Met Asp Met Ser Arg Gly Arg Ser Ile
            580                 585                 590

Ser Arg Ala Asn Ser Glu Gly His Val Ala Ala Val Glu Val Leu Arg
        595                 600                 605

Gly Ile His Arg Ile Ala Asp Met Ser Glu Gly Glu Thr Lys Gln Cys
    610                 615                 620

Leu Gln Ser Leu Val Lys Thr Ile Val Gln Ser Asp Ser Tyr Tyr Asp
625                 630                 635                 640
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Val Phe Lys Asn Leu Lys Thr Tyr Lys Asp Ile Ser Leu Met Gln Ser
645 650 655

Leu Leu Ser Asp Ala Gly Val Ala Ser Val Pro Arg Pro Ser Tyr Leu
660 665 670

Ser Ala Phe Asn Lys Met Asp Lys Thr Ala Met Tyr Asn Ala Glu Lys
675 680 685

Gly Phe Gly Phe Gly Leu Ser Leu Phe Ser Ser Arg Thr Leu Asn Tyr
690 695 700

Glu His Met Asn Lys Glu Asn Lys Arg Gly Trp Tyr Thr Ser Asp Gly
705 710 715 720

Met Phe Tyr Leu Tyr Asn Gly Asp Leu Ser His Tyr Ser Asp Gly Tyr
725 730 735

Trp Pro Thr Val Asn Pro Tyr Lys Met Pro Gly Thr Thr Glu Thr Asp
740 745 750

Ala Lys Arg Ala Asp Ser Asp Thr Gly Lys Val Leu Pro Ser Ala Phe
755 760 765

Val Gly Thr Ser Lys Leu Asp Asp Ala Asn Ala Thr Ala Thr Met Asp
770 775 780

Phe Thr Asn Trp Asn Gln Thr Leu Thr Ala His Lys Ser Trp Phe Met
785 790 795 800

Leu Lys Asp Lys Ile Ala Phe Leu Gly Ser Asn Ile Gln Asn Thr Ser
805 810 815

Thr Asp Thr Ala Ala Thr Thr Ile Asp Gln Arg Lys Leu Glu Ser Gly
820 825 830

Asn Pro Tyr Lys Val Tyr Val Asn Asp Lys Glu Ala Ser Leu Thr Glu
835 840 845

Gln Glu Lys Asp Tyr Pro Glu Thr Gln Ser Val Phe Leu Glu Ser Phe

850 855 860

Asp Ser Lys Lys Asn Ile Gly Tyr Phe Phe Phe Lys Lys Ser Ser Ile
865 870 875 880

Ser Met Ser Lys Ala Leu Gln Lys Gly Ala Trp Lys Asp Ile Asn Glu
885 890 895

Gly Gln Ser Asp Lys Glu Val Glu Asn Glu Phe Leu Thr Ile Ser Gln
900 905 910

Ala His Lys Gln Asn Arg Asp Ser Tyr Gly Tyr Met Leu Ile Pro Asn
915 920 925

Val Asp Arg Ala Thr Phe Asn Gln Met Ile Lys Glu Leu Glu Ser Ser
930 935 940

Leu Ile Glu Asn Asn Glu Thr Leu Gln Ser Val Tyr Asp Ala Lys Gln
945 950 955 960

Gly Val Trp Gly Ile Val Lys Tyr Asp Asp Ser Val Ser Thr Ile Ser
965 970 975

Asn Gln Phe Gln Val Leu Lys Arg Gly Val Tyr Thr Ile Arg Lys Glu
980 985 990

Gly Asp Glu Tyr Lys Ile Ala Tyr Tyr Asn Pro Glu Thr Gln Glu Ser
995 1000 1005

Ala Pro Asp Gln Glu Val Phe Lys Lys Leu Glu Gln Ala Ala Gln
1010 1015 1020

Pro Gln Val Gln Asn Ser Lys Glu Lys Glu Lys Ser Glu Glu Glu
1025 1030 1035

Lys Asn His Ser Asp Gln Lys Asn Leu Pro Gln Thr Gly Glu Gly
1040 1045 1050

Gln Ser Ile Leu Ala Ser Leu Gly Phe Leu Leu Leu Gly Ala Phe
1055 1060 1065

Tyr Leu Phe Arg Arg Gly Lys Asn Asn
1070 1075

<210> 229
<211> 259
<212> PRT
<213> Streptococcus pneumoniae

<400> 229

Met Ser Ile Asn Val Phe Gln Ala Ile Leu Ile Gly Leu Trp Thr Ala
1 5 10 15

Phe Cys Phe Ser Gly Met Leu Leu Gly Ile Tyr Thr Asn Arg Cys Ile
20 25 30

Val Leu Ser Phe Gly Val Gly Ile Ile Leu Gly Asp Leu Pro Thr Ala
35 40 45

Leu Ala Met Gly Ala Ile Gly Glu Leu Ala Tyr Met Gly Phe Gly Val
50 55 60

Gly Ala Gly Gly Thr Val Pro Pro Asn Pro Ile Gly Pro Gly Ile Phe
65 70 75 80

Gly Thr Leu Met Ala Ile Thr Ser Ala Gly Lys Val Ser Pro Glu Ala
85 90 95

Ala Leu Ala Leu Ser Thr Pro Ile Ala Val Ala Ile Gln Phe Leu Gln
100 105 110

Thr Phe Ala Tyr Thr Val Arg Ala Gly Ala Pro Glu Thr Ala Met Lys
115 120 125

His Leu Lys Asn His Asn Leu Lys Lys Phe Lys Phe Thr Leu Asn Ala
130 135 140

Thr Ile Trp Leu Phe Ala Phe Ile Gly Phe Thr Leu Gly Cys Leu Gly
145 150 155 160

Ala Leu Ser Met Asp Thr Leu Leu Lys Leu Val Asp Tyr Ile Pro Pro
165 170 175

Val Leu Leu Thr Gly Leu Thr Val Ala Gly Lys Met Leu Pro Ala Ile
180 185 190

Gly Phe Ala Met Ile Leu Ser Val Met Ala Lys Lys Glu Leu Ile Pro
195 200 205

Phe Val Leu Leu Gly Tyr Val Cys Ala Ala Tyr Leu Asn Ile Pro Thr
210 215 220

Ile Gly Ile Ala Ile Val Gly Thr Ile Phe Ala Leu Ile Glu Phe Tyr
225 230 235 240

Asn Lys Pro Lys Thr Ala Asp His Val Val Glu Glu Glu Ala His Asp
245 250 255

Asp Trp Ile

<210> 230
<211> 111
<212> PRT
<213> Streptococcus pneumoniae

<400> 230

Met Lys Ser Leu Ala Arg Leu Leu Ile Ile His Val Phe Ile Ser Ile
1 5 10 15

Phe Leu Phe Phe Ala Leu Thr Ser Gly Ala Ile Ser His Thr Val Leu
20 25 30

Leu Leu Leu Leu Leu Phe Leu Pro Ala Leu Asn Lys Gly Leu Glu Lys
35 40 45

Ile Gln Ser Lys Arg Ile Pro Val Leu Asn Ala Ala Leu Phe Phe Leu
50 55 60

Leu Ile Ser Phe Pro Gln Leu Leu Thr Asn Pro Val Gln Trp Lys Phe
65 70 75 80

Ser Ile Phe Leu Val Val Thr Ile Ile Ser Ser Leu Ala Tyr Phe Tyr
85 90 95

Asn Phe Tyr Gln Val Val Lys Glu Val Asp Gln Lys Gln Leu Ile
100 105 110

<210> 231
<211> 750
<212> PRT
<213> Streptococcus pneumoniae

<400> 231

Met Lys Trp Thr Lys Arg Val Ile Arg Tyr Ala Thr Lys Asn Arg Lys
1 5 10 15

Ser Pro Ala Glu Asn Arg Arg Arg Val Gly Lys Ser Leu Ser Leu Leu
20 25 30

Ser Val Phe Val Phe Ala Ile Phe Leu Val Asn Phe Ala Val Ile Ile
35 40 45

Gly Thr Gly Thr Arg Phe Gly Thr Asp Leu Ala Lys Glu Ala Lys Lys
50 55 60

Val His Gln Thr Thr Arg Thr Val Pro Ala Lys Arg Gly Thr Ile Tyr
65 70 75 80

Asp Arg Asn Gly Val Pro Ile Ala Glu Asp Ala Thr Ser Tyr Asn Val
85 90 95

Tyr Ala Val Ile Asp Glu Asn Tyr Lys Ser Ala Thr Gly Lys Ile Leu
100 105 110

Tyr Val Glu Lys Thr Gln Phe Asn Lys Val Ala Glu Val Phe His Lys
115 120 125

Tyr Leu Asp Met Glu Glu Ser Tyr Val Arg Glu Gln Leu Ser Gln Pro
130 135 140

Asn Leu Lys Gln Val Ser Phe Gly Ala Lys Gly Asn Gly Ile Thr Tyr
145 150 155 160

Ala Asn Met Met Ser Ile Lys Lys Glu Leu Glu Ala Ala Glu Val Lys
165 170 175

Gly Ile Asp Phe Thr Thr Ser Pro Asn Arg Ser Tyr Pro Asn Gly Gln
180 185 190

Phe Ala Ser Ser Phe Ile Gly Leu Ala Gln Leu His Glu Asn Glu Asp
195 200 205

Gly Ser Lys Ser Leu Leu Gly Thr Ser Gly Met Glu Ser Ser Leu Asn
210 215 220

Ser Ile Leu Ala Gly Thr Asp Gly Ile Ile Thr Tyr Glu Lys Asp Arg
225 230 235 240

Leu Gly Asn Ile Val Pro Gly Thr Glu Gln Val Ser Gln Arg Thr Met
245 250 255

Asp Gly Lys Asp Val Tyr Thr Thr Ile Ser Ser Pro Leu Gln Ser Phe
260 265 270

Met Glu Thr Gln Met Asp Ala Phe Gln Glu Lys Val Lys Gly Lys Tyr
275 280 285

Met Thr Ala Thr Leu Val Ser Ala Lys Thr Gly Glu Ile Leu Ala Thr
290 295 300

Thr Gln Arg Pro Thr Phe Asp Ala Asp Thr Lys Glu Gly Ile Thr Glu
305 310 315 320

Asp Phe Val Trp Arg Asp Ile Leu Tyr Gln Ser Asn Tyr Glu Pro Gly
325 330 335

Ser Thr Met Lys Val Met Met Leu Ala Ala Ala Ile Asp Asn Asn Thr
340 345 350

Phe Pro Gly Gly Glu Val Phe Asn Ser Ser Glu Leu Lys Ile Ala Asp
355 360 365

Ala Thr Ile Arg Asp Trp Asp Val Asn Glu Gly Leu Thr Gly Gly Arg
370 375 380

Thr Met Thr Phe Ser Gln Gly Phe Ala His Ser Ser Asn Val Gly Met
385 390 395 400

Thr Leu Leu Glu Gln Lys Met Gly Asp Ala Thr Trp Leu Asp Tyr Leu
405 410 415

Asn Arg Phe Lys Phe Gly Val Pro Thr Arg Phe Gly Leu Thr Asp Glu
420 425 430

Tyr Ala Gly Gln Leu Pro Ala Asp Asn Ile Val Asn Ile Ala Gln Ser
435 440 445

Ser Phe Gly Gln Gly Ile Ser Val Thr Gln Thr Gln Met Ile Arg Ala
450 455 460

Phe Thr Ala Ile Ala Asn Asp Gly Val Met Leu Glu Pro Lys Phe Ile
465 470 475 480

Ser Ala Ile Tyr Asp Pro Asn Asp Gln Thr Ala Arg Lys Ser Gln Lys
485 490 495

Glu Ile Val Gly Asn Pro Val Ser Lys Asp Ala Ala Ser Leu Thr Arg
500 505 510

Thr Asn Met Val Leu Val Gly Thr Asp Pro Val Tyr Gly Thr Met Tyr
515 520 525

Asn His Ser Thr Gly Lys Pro Thr Val Thr Val Pro Gly Gln Asn Val
530 535 540

Ala Leu Lys Ser Gly Thr Ala Gln Ile Ala Asp Glu Lys Asn Gly Gly
545 550 555 560

Tyr Leu Val Gly Leu Thr Asp Tyr Ile Phe Ser Ala Val Ser Met Ser
565 570 575

Pro Ala Glu Asn Pro Asp Phe Ile Leu Tyr Val Thr Val Gln Gln Pro
580 585 590

Glu His Tyr Ser Gly Ile Gln Leu Gly Glu Phe Ala Asn Pro Ile Leu
595 600 605

Glu Arg Ala Ser Ala Met Lys Asp Ser Leu Asn Leu Gln Thr Thr Ala
610 615 620

Lys Ala Leu Glu Gln Val Ser Gln Gln Ser Pro Tyr Pro Met Pro Ser
625 630 635 640

Val Lys Asp Ile Ser Pro Gly Asp Leu Ala Glu Glu Leu Arg Arg Asn
645 650 655

Leu Val Gln Pro Ile Val Val Gly Thr Gly Thr Lys Ile Lys Asn Ser
660 665 670

Ser Ala Glu Glu Gly Lys Asn Leu Ala Pro Asn Gln Gln Val Leu Ile
675 680 685

Leu Ser Asp Lys Ala Glu Glu Val Pro Asp Met Tyr Gly Trp Thr Lys
690 695 700

Glu Thr Ala Glu Thr Leu Ala Lys Trp Leu Asn Ile Glu Leu Glu Phe
705 710 715 720

Gln Gly Ser Gly Ser Thr Val Gln Lys Gln Asp Val Arg Ala Asn Thr
725 730 735

Ala Ile Lys Asp Ile Lys Lys Ile Thr Leu Thr Leu Gly Asp
740 745 750

<210> 232
<211> 217
<212> PRT
<213> Streptococcus pneumoniae

<400> 232

Met Ser Asn Gly Asn Arg Met Lys Asn Gly Asn Arg Ile Tyr Ser Trp
1 5 10 15

Arg Leu Phe Met Tyr Gly Ile Ile Lys Arg Leu Gly Asp Ile Leu Leu
20 25 30

Ser Leu Ile Gly Ile Ile Ile Leu Cys Pro Val Phe Met Ile Ile Ala
35 40 45

Ile Ala Ile Lys Leu Asp Ser Glu Gly Pro Val Ile Phe Lys Gln Lys
50 55 60

Arg Phe Gly Ile His Lys Glu Tyr Phe Tyr Ile Leu Lys Phe Arg Ser
65 70 75 80

Met Lys Ile Asp Ala Pro Lys Asn Val Ala Pro Arg Asn Leu Tyr Asn
85 90 95

Pro Glu Gln Trp Ile Thr Lys Val Gly Ala Phe Leu Arg Lys Thr Ser
100 105 110

Leu Asp Glu Leu Pro Gln Leu Phe Asn Ile Leu Val Gly Asn Met Ser
115 120 125

Ile Val Gly Pro Arg Pro Ala Gly Ile Asn Glu Leu Asp Leu Ile Ala
130 135 140

Glu Arg Asp Lys Tyr Gly Ala Asn Asp Ile Leu Pro Gly Leu Thr Gly
145 150 155 160

Trp Ala Gln Ile Asn Gly Arg Asp Thr Leu Ser Val Glu Met Lys Thr
165 170 175

Glu Leu Asp Gly Tyr Tyr Val Lys His Leu Ser Leu Ile Met Asp Ile
180 185 190

Arg Cys Ile Val Lys Thr Ile Pro Tyr Val Leu Lys Arg Lys Gly Ile
195 200 205

Val Glu Gly Ser Gly Lys Lys Glu Ser
210 215

<210> 233
<211> 409
<212> PRT
<213> Streptococcus pneumoniae

<400> 233

Met Lys Ile Leu Phe Val Cys Gln His Tyr Lys Pro Glu Pro Phe Arg
1 5 10 15

Leu Ser Asp Ile Cys Glu Asp Leu Val Arg Lys Gly His Glu Val Ser
20 25 30

Val Leu Ala Gly Ile Pro Asn Tyr Pro Glu Gly Lys Ile Tyr Ala Asp
35 40 45

Tyr Arg His Asn Lys Lys Arg Arg Glu Ile Ile Glu Gly Val Thr Ile
50 55 60

Tyr Arg Ser Tyr Thr Ile Pro Arg Lys Lys Ser Val Val Phe Arg Leu
65 70 75 80

Leu Asn Tyr Phe Ser Phe Ala Ile Ser Ser Thr Leu Gly Val Leu Leu
85 90 95

Gly Arg Tyr Lys Thr Lys Asp Gly Ser Asn Phe Asp Cys Val Phe Val
100 105 110

Asn Gln Leu Ser Pro Val Met Met Ala Trp Ala Gly Met Ala Tyr Lys
115 120 125

Lys Lys Tyr Lys Lys Pro Met Phe Leu Tyr Cys Met Asp Val Trp Pro
130 135 140

Asp Ser Leu Thr Val Gly Gly Val Lys Gln Asp Gly Leu Ile Phe Lys
145 150 155 160

Leu Phe Lys Phe Ile Ser Lys Lys Val Tyr Arg Ala Ser Asp Tyr Ile
165 170 175

Phe Val Thr Ser Pro Ser Phe Lys Asn Tyr Phe Val Lys Gln Phe Asp
180 185 190

Ile Ser Glu Gln Lys Ile Thr Tyr Leu Pro Gln Tyr Ala Glu Asp Leu
195 200 205

Phe Ile Pro Asp Glu Ser Ile Val Asn Lys Glu Ser Val Asp Leu Thr
210 215 220

Phe Ala Gly Asn Ile Gly Lys Ala Gln Asn Leu Glu Thr Ile Leu Lys
225 230 235 240

Ala Ala Ser Leu Ile Glu Lys Asn Thr Asn Leu Pro Lys Lys Ile His

```
                245                 250                 255

Phe His Phe Val Gly Asp Gly Thr Glu Leu Leu Ser Met Lys Ala Leu
            260                 265                 270

Ala His Glu Leu Glu Leu Lys Asn Ile Ser Phe Tyr Gly Arg Arg Ser
        275                 280                 285

Leu Glu Glu Met Pro Ser Phe Tyr Lys Lys Ser Asp Ala Met Leu Val
    290                 295                 300

Ser Leu Ile Gly Asp Ser Ile Val Ser Arg Thr Ile Pro Gly Lys Val
305                 310                 315                 320

Gln Ser Tyr Met Ala Ala Gly Lys Pro Ile Ile Gly Ala Ile Ser Gly
                325                 330                 335

Asp Ala Lys Ile Ile Val Glu Glu Ala Asn Cys Gly Tyr Val Ser Pro
            340                 345                 350

Glu Arg Asp Val Lys Gln Leu Ala Lys Asn Ile Cys Lys Phe Ser Met
        355                 360                 365

Leu Ser Ile Lys Arg Gln Arg Glu Leu Gly Lys Lys Ala Arg Cys Tyr
    370                 375                 380

Tyr Glu Asn His Phe Ser Lys Glu Gln Phe Met Leu Glu Leu Glu Thr
385                 390                 395                 400

Cys Leu Glu Arg Glu Ser Lys Lys Glu
                405
```

<210> 234
<211> 372
<212> PRT
<213> Streptococcus pneumoniae

<400> 234

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Met Ile Lys Val Leu His Leu Phe Thr Thr Leu Asp Ser Gly Gly Val
1               5                   10                  15

Glu Ser Phe Leu Phe Asn Tyr Tyr Ser His Ile Asp Arg Lys Lys Ile
```

20 25 30

Gln Phe Asp Phe Ile Val Pro Gly Lys Glu Gln Gly Phe Leu Glu Asp
35 40 45

Lys Met Lys Glu Leu Gly Ala Lys Val Tyr His Val Pro Leu Leu Arg
50 55 60

Lys Lys Pro Leu His Gln Phe Leu Ser Leu Ala Arg Ile Ile Lys Lys
65 70 75 80

Gly Asp Tyr Asp Ile Val His Cys His Gly Tyr Lys Ser Ala Ile Gly
85 90 95

Leu Ile Leu Ser Lys Ile Ile Gly Cys Lys Ile Arg Ile Ile His Ser
100 105 110

His Met Ala Tyr Val Thr Glu Asn Ser Phe Gln Lys Val Leu Arg Lys
115 120 125

Leu Val Thr Ile Leu Val Lys Ile Leu Ala Thr His Trp Phe Ala Cys
130 135 140

Gly Glu Asp Ser Ala Lys Trp Leu Tyr Gly Glu Lys Ala Tyr Lys Asp
145 150 155 160

Gly Lys Ile Glu Ile Ile Phe Asn Ala Ile Asp Leu Lys Lys Tyr Gln
165 170 175

Phe Leu Ser Asp Val Arg Glu Lys Cys Arg Arg Glu Leu Asp Val Ser
180 185 190

Asn Lys Phe Val Leu Gly Asn Ile Ala Arg Leu Ser Asp Gln Lys Asn
195 200 205

Gln Ser Tyr Leu Phe Asn Val Leu Lys Glu Leu Ile Leu Ile Lys Pro
210 215 220

Asn Val Ile Leu Leu Leu Val Gly Asn Gly Glu Asp Glu Gln Lys Leu
225 230 235 240

Lys Gln Lys Ala Leu Glu Leu Asn Leu Thr Pro Tyr Val Leu Phe Leu
245 250 255

Gly Arg Arg Thr Asp Ile Ser Asp Leu Leu Ser Ala Met Asp Val Phe
260 265 270

Leu Leu Pro Ser Lys Tyr Glu Gly Leu Pro Val Ser Leu Val Glu Ala
275 280 285

Gln Ala Ser Gly Leu Gln Ile Leu Ser Ser Asp Thr Val Thr Gln Glu
290 295 300

Val Asp Val Thr Lys Asn Ile Ser Tyr Leu Pro Ile Asn Glu Glu Ser
305 310 315 320

Val Leu Leu Trp Lys Asp Lys Val Leu Ser Leu Thr Ser Glu Glu Cys
325 330 335

Asn Arg Phe Glu Ile Asn Asn Ser Met Thr Asp Gly Leu Tyr Asp Ile
340 345 350

Cys Tyr Gln Ala Ser Lys Leu Leu Asn Arg Tyr Gln Glu Met Cys Val
355 360 365

Ile Lys Glu Ile
370

<210> 235
<211> 413
<212> PRT
<213> Streptococcus pneumoniae

<400> 235

Met Lys Val Asp Arg Ile Ser Phe Ile Lys Asn Thr Ser Ser Leu Tyr
1 5 10 15

Ile Leu Asn Ile Val Lys Leu Leu Phe Pro Leu Leu Thr Leu Pro Tyr
20 25 30

Leu Thr Arg Val Leu Ser Leu Asp Ala Tyr Gly Met Val Ile Tyr Val
35 40 45

Lys Ala Leu Ile Ala Tyr Val Gln Leu Val Ile Asp Phe Gly Phe Met
50 55 60

Ile Ser Ala Thr Lys Asn Ile Val Asn Ala Cys Thr Thr Pro Ser Lys
65 70 75 80

Ile Gly Arg Ile Val Gly Asp Thr Leu Val Glu Lys Ile Phe Leu Ser
85 90 95

Ile Ile Ser Ile Leu Ile Tyr Thr Ile Leu Met Trp Gln Ile Pro Ile
100 105 110

Met Arg Glu Asn Ile Leu Phe Ser Val Phe Tyr Leu Leu Ala Thr Val
115 120 125

Thr Asn Ile Phe Ile Phe Asp Phe Leu Phe Arg Gly Ile Glu Lys Met
130 135 140

His Ala Val Ala Ile Pro Tyr Ile Ile Ser Lys Thr Ile Ile Thr Ile
145 150 155 160

Leu Thr Phe Ile Val Val Lys Asp Asp Ser Ser Ile Leu Trp Ile Pro
165 170 175

Ile Leu Glu Gly Ile Gly Asn Leu Val Ala Ala Val Val Ser Tyr Arg
180 185 190

Phe Leu His Tyr Tyr Gly Ile Lys Leu Ser Phe Ser Tyr Leu Ser Val
195 200 205

Trp Val Lys Asp Leu Lys Glu Ser Ser Ile Tyr Phe Leu Ser Asn Phe
210 215 220

Ala Thr Thr Ile Phe Gly Val Phe Thr Thr Val Ile Ser Gly Phe Tyr
225 230 235 240

Leu Gln Ser Gln Glu Ile Ala Phe Trp Gly Ile Ala Met Gln Leu Leu
245 250 255

Ser Ala Ala Lys Ser Leu Tyr Asn Pro Ile Ala Asn Ser Leu Tyr Pro
260 265 270

His Met Ile Arg Thr Lys Asp Ile Gln Ser Val Lys Ser Ile Asn Arg
275 280 285

Ile Met Phe Ile Pro Ile Ile Phe Gly Val Leu Ile Val Leu Phe Phe
290 295 300

Ser Asn Gln Ile Leu Ser Ile Ile Gly Gly Glu Lys Tyr Thr Val Ser
305 310 315 320

Ala Asp Phe Leu Lys Tyr Leu Leu Pro Ala Phe Val Ala Ser Phe Tyr
325 330 335

Ser Met Ile Tyr Gly Trp Pro Val Leu Gly Ala Ile Asp Lys Val Lys
340 345 350

Glu Thr Thr Met Thr Thr Ile Leu Ala Ser Ile Val Gln Thr Leu Gly
355 360 365

Leu Gly Ile Phe Ile Leu Ser Asp Asn Phe Ser Leu Val Thr Leu Ala
370 375 380

Ile Cys Ser Ser Met Ser Glu Val Val Leu Trp Ile Ser Arg Tyr Leu
385 390 395 400

Ile Tyr Phe Lys Asn Arg Ser Leu Phe Val Arg Ser Lys
405 410

<210> 236
<211> 1767
<212> PRT
<213> Streptococcus pneumoniae

<400> 236

Met Asn Lys Gly Leu Phe Glu Lys Arg Cys Lys Tyr Ser Ile Arg Lys
1 5 10 15

Phe Ser Leu Gly Val Ala Ser Val Met Ile Gly Ala Ala Phe Phe Gly
20 25 30

Thr Ser Pro Val Leu Ala Asp Ser Val Gln Ser Gly Ser Thr Ala Asn
35 40 45

Leu Pro Ala Asp Leu Ala Thr Ala Leu Ala Thr Ala Lys Glu Asn Asp
50 55 60

Gly Arg Asp Phe Glu Ala Pro Lys Val Gly Glu Asp Gln Gly Ser Pro
65 70 75 80

Glu Val Thr Asp Gly Pro Lys Thr Glu Glu Glu Leu Leu Ala Leu Glu
85 90 95

Lys Glu Lys Pro Ala Glu Glu Lys Pro Lys Glu Asp Lys Pro Ala Ala
100 105 110

Ala Lys Pro Glu Thr Pro Lys Thr Val Thr Pro Glu Trp Gln Thr Val
115 120 125

Ala Asn Lys Glu Gln Gln Gly Thr Val Thr Ile Arg Glu Glu Lys Gly
130 135 140

Val Arg Tyr Asn Gln Leu Ser Ser Thr Ala Gln Asn Asp Asn Ala Gly
145 150 155 160

Lys Pro Ala Leu Phe Glu Lys Lys Gly Leu Thr Val Asp Ala Asn Gly
165 170 175

Asn Ala Thr Val Asp Leu Thr Phe Lys Asp Asp Ser Glu Lys Gly Lys
180 185 190

Ser Arg Phe Gly Val Phe Leu Lys Phe Lys Asp Thr Lys Asn Asn Val
195 200 205

Phe Val Gly Tyr Asp Lys Asp Gly Trp Phe Trp Glu Tyr Lys Ser Pro
210 215 220

Thr Thr Ser Thr Trp Tyr Arg Gly Ser Arg Val Ala Ala Pro Glu Thr
225 230 235 240

Gly Ser Thr Asn Arg Leu Ser Ile Thr Leu Lys Ser Asp Gly Gln Leu
245 250 255

Asn Ala Ser Asn Asn Asp Val Asn Leu Phe Asp Thr Val Thr Leu Pro
260 265 270

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Ala Ala Val Asn Asp His Leu Lys Asn Glu Lys Lys Ile Leu Leu Lys
        275                 280                 285

Ala Gly Ser Tyr Asp Asp Glu Arg Thr Val Val Ser Val Lys Thr Asp
    290                 295                 300

Asn Gln Glu Gly Val Lys Thr Glu Asp Thr Pro Ala Glu Lys Glu Thr
305                 310                 315                 320

Gly Pro Glu Val Asp Asp Ser Lys Val Thr Tyr Asp Thr Ile Gln Ser
                325                 330                 335

Lys Val Leu Lys Ala Val Ile Asp Gln Ala Phe Pro Arg Val Lys Glu
            340                 345                 350

Tyr Ser Leu Asn Gly His Thr Leu Pro Gly Gln Val Gln Gln Phe Asn
        355                 360                 365

Gln Val Phe Ile Asn Asn His Arg Ile Thr Pro Glu Val Thr Tyr Lys
    370                 375                 380

Lys Ile Asn Glu Thr Thr Ala Glu Tyr Leu Met Lys Leu Arg Asp Asp
385                 390                 395                 400

Ala His Leu Ile Asn Ala Glu Met Thr Val Arg Leu Gln Val Val Asp
                405                 410                 415

Asn Gln Leu His Phe Asp Val Thr Lys Ile Val Asn His Asn Gln Val
            420                 425                 430

Thr Pro Gly Gln Lys Ile Asp Asp Glu Ser Lys Leu Leu Ser Ser Ile
        435                 440                 445

Ser Phe Leu Gly Asn Ala Leu Val Ser Val Ser Ser Asn Gln Thr Gly
    450                 455                 460

Ala Lys Phe Asp Gly Ala Thr Met Ser Asn Asn Thr His Val Ser Gly
465                 470                 475                 480

Asp Asp His Ile Asp Val Thr Asn Pro Met Lys Asp Leu Ala Lys Gly
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485 490 495

Tyr Met Tyr Gly Phe Val Ser Thr Asp Lys Leu Ala Ala Gly Val Trp
500 505 510

Ser Asn Ser Gln Asn Ser Tyr Gly Gly Gly Ser Asn Asp Trp Thr Arg
515 520 525

Leu Thr Ala Tyr Lys Glu Thr Val Gly Asn Ala Asn Tyr Val Gly Ile
530 535 540

His Ser Ser Glu Trp Gln Trp Glu Lys Ala Tyr Lys Gly Ile Val Phe
545 550 555 560

Pro Glu Tyr Thr Lys Glu Leu Pro Ser Ala Lys Val Val Ile Thr Glu
565 570 575

Asp Ala Asn Ala Asp Lys Asn Val Asp Trp Gln Asp Gly Ala Ile Ala
580 585 590

Tyr Arg Ser Ile Met Asn Asn Pro Gln Gly Trp Glu Lys Val Lys Asp
595 600 605

Ile Thr Ala Tyr Arg Ile Ala Met Asn Phe Gly Ser Gln Ala Gln Asn
610 615 620

Pro Phe Leu Met Thr Leu Asp Gly Ile Lys Lys Ile Asn Leu His Thr
625 630 635 640

Asp Gly Leu Gly Gln Gly Val Leu Leu Lys Gly Tyr Gly Ser Glu Gly
645 650 655

His Asp Ser Gly His Leu Asn Tyr Ala Asp Ile Gly Lys Arg Ile Gly
660 665 670

Gly Val Glu Asp Phe Lys Thr Leu Ile Glu Lys Ala Lys Lys Tyr Gly
675 680 685

Ala His Leu Gly Ile His Val Asn Ala Ser Glu Thr Tyr Pro Glu Ser
690 695 700

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Lys Tyr Phe Asn Glu Lys Ile Leu Arg Lys Asn Pro Asp Gly Ser Tyr
705                 710                 715                 720

Ser Tyr Gly Trp Asn Trp Leu Asp Gln Gly Ile Asn Ile Asp Ala Ala
                725                 730                 735

Tyr Asp Leu Ala His Gly Arg Leu Ala Arg Trp Glu Asp Leu Lys Lys
            740                 745                 750

Lys Leu Gly Asp Gly Leu Asp Phe Ile Tyr Val Asp Val Trp Gly Asn
        755                 760                 765

Gly Gln Ser Gly Asp Asn Gly Ala Trp Ala Thr His Val Leu Ala Lys
    770                 775                 780

Glu Ile Asn Lys Gln Gly Trp Arg Phe Ala Ile Glu Trp Gly His Gly
785                 790                 795                 800

Gly Glu Tyr Asp Ser Thr Phe His His Trp Ala Ala Asp Leu Thr Tyr
                805                 810                 815

Gly Gly Tyr Thr Asn Lys Gly Ile Asn Ser Ala Ile Thr Arg Phe Ile
            820                 825                 830

Arg Asn His Gln Lys Asp Ala Trp Val Gly Asp Tyr Arg Ser Tyr Gly
        835                 840                 845

Gly Ala Ala Asn Tyr Pro Leu Leu Gly Gly Tyr Ser Met Lys Asp Phe
    850                 855                 860

Glu Gly Trp Gln Gly Arg Ser Asp Tyr Asn Gly Tyr Val Thr Asn Leu
865                 870                 875                 880

Phe Ala His Asp Val Met Thr Lys Tyr Phe Gln His Phe Thr Val Ser
                885                 890                 895

Lys Trp Glu Asn Gly Thr Pro Val Thr Met Thr Asp Asn Gly Ser Thr
            900                 905                 910

Tyr Lys Trp Thr Pro Glu Met Arg Val Glu Leu Val Asp Ala Asp Asn
        915                 920                 925
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Asn Lys Val Val Val Thr Arg Lys Ser Asn Asp Val Asn Ser Pro Gln
930 935 940

Tyr Arg Glu Arg Thr Val Thr Leu Asn Gly Arg Val Ile Gln Asp Gly
945 950 955 960

Ser Ala Tyr Leu Thr Pro Trp Asn Trp Asp Ala Asn Gly Lys Lys Leu
965 970 975

Ser Thr Asp Lys Glu Lys Met Tyr Tyr Phe Asn Thr Gln Ala Gly Ala
980 985 990

Thr Thr Trp Thr Leu Pro Ser Asp Trp Ala Lys Ser Lys Val Tyr Leu
995 1000 1005

Tyr Lys Leu Thr Asp Gln Gly Lys Thr Glu Glu Gln Glu Leu Thr
1010 1015 1020

Val Lys Asp Gly Lys Ile Thr Leu Asp Leu Leu Ala Asn Gln Pro
1025 1030 1035

Tyr Val Leu Tyr Arg Ser Lys Gln Thr Asn Pro Glu Met Ser Trp
1040 1045 1050

Ser Glu Gly Met His Ile Tyr Asp Gln Gly Phe Asn Ser Gly Thr
1055 1060 1065

Leu Lys His Trp Thr Ile Ser Gly Asp Ala Ser Lys Ala Glu Ile
1070 1075 1080

Val Lys Ser Gln Gly Ala Asn Asp Met Leu Arg Ile Gln Gly Asn
1085 1090 1095

Lys Glu Lys Val Ser Leu Thr Gln Lys Leu Thr Gly Leu Lys Pro
1100 1105 1110

Asn Thr Lys Tyr Ala Val Tyr Val Gly Val Asp Asn Arg Ser Asn
1115 1120 1125

Ala Lys Ala Ser Ile Thr Val Asn Thr Gly Glu Lys Glu Val Thr
1130 1135 1140

Thr Tyr Thr Asn Lys Ser Leu Ala Leu Asn Tyr Val Lys Ala Tyr
1145 1150 1155

Ala His Asn Thr Arg Arg Asp Asn Ala Thr Val Asp Asp Thr Ser
1160 1165 1170

Tyr Phe Gln Asn Met Tyr Ala Phe Phe Thr Thr Gly Ala Asp Val
1175 1180 1185

Ser Asn Val Thr Leu Thr Leu Ser Arg Glu Ala Gly Asp Gln Ala
1190 1195 1200

Thr Tyr Phe Asp Glu Ile Arg Thr Phe Glu Asn Asn Ser Ser Met
1205 1210 1215

Tyr Gly Asp Lys His Asp Thr Gly Lys Gly Thr Phe Lys Gln Asp
1220 1225 1230

Phe Glu Asn Val Ala Gln Gly Ile Phe Pro Phe Val Val Gly Gly
1235 1240 1245

Val Glu Gly Val Glu Asp Asn Arg Thr His Leu Ser Glu Lys His
1250 1255 1260

Asn Pro Tyr Thr Gln Arg Gly Trp Asn Gly Lys Lys Val Asp Asp
1265 1270 1275

Val Ile Glu Gly Asn Trp Ser Leu Lys Thr Asn Gly Leu Val Ser
1280 1285 1290

Arg Arg Asn Leu Val Tyr Gln Thr Ile Pro Gln Asn Phe Arg Phe
1295 1300 1305

Glu Ala Gly Lys Thr Tyr Arg Val Thr Phe Glu Tyr Glu Ala Gly
1310 1315 1320

Ser Asp Asn Thr Tyr Ala Phe Val Val Gly Lys Gly Glu Phe Gln
1325 1330 1335

Ser Gly Arg Arg Gly Thr Gln Ala Ser Asn Leu Glu Met His Glu

1340 1345 1350

Leu Pro Asn Thr Trp Thr Asp Ser Lys Lys Ala Lys Lys Ala Thr
1355 1360 1365

Phe Leu Val Thr Gly Ala Glu Thr Gly Asp Thr Trp Val Gly Ile
1370 1375 1380

Tyr Ser Thr Gly Asn Ala Ser Asn Thr Arg Gly Asp Ser Gly Gly
1385 1390 1395

Asn Ala Asn Phe Arg Gly Tyr Asn Asp Phe Met Met Asp Asn Leu
1400 1405 1410

Gln Ile Glu Glu Ile Thr Leu Thr Gly Lys Met Leu Thr Glu Asn
1415 1420 1425

Ala Leu Lys Asn Tyr Leu Pro Thr Val Ala Met Thr Asn Tyr Thr
1430 1435 1440

Lys Glu Ser Met Asp Ala Leu Lys Glu Ala Val Phe Asn Leu Ser
1445 1450 1455

Gln Ala Asp Asp Asp Ile Ser Val Glu Glu Ala Arg Ala Glu Ile
1460 1465 1470

Ala Lys Ile Glu Ala Leu Lys Asn Ala Leu Val Gln Lys Lys Thr
1475 1480 1485

Ala Leu Val Ala Asp Asp Phe Ala Ser Leu Thr Ala Pro Ala Gln
1490 1495 1500

Ala Gln Glu Gly Leu Ala Asn Ala Phe Asp Gly Asn Val Ser Ser
1505 1510 1515

Leu Trp His Thr Ser Trp Asn Gly Gly Asp Val Gly Lys Pro Ala
1520 1525 1530

Thr Met Val Leu Lys Glu Pro Thr Glu Ile Thr Gly Leu Arg Tyr
1535 1540 1545

Val Pro Arg Gly Ser Gly Ser Asn Gly Asn Leu Arg Asp Val Lys
1550 1555 1560

Leu Val Val Thr Asp Glu Ser Gly Lys Glu His Thr Phe Thr Ala
1565 1570 1575

Thr Asp Trp Pro Asn Asn Asn Lys Pro Lys Asp Ile Asp Phe Gly
1580 1585 1590

Lys Thr Ile Lys Ala Lys Lys Ile Val Leu Thr Gly Thr Lys Thr
1595 1600 1605

Tyr Gly Asp Gly Gly Asp Lys Tyr Gln Ser Ala Ala Glu Leu Ile
1610 1615 1620

Phe Thr Arg Pro Gln Val Ala Glu Thr Pro Leu Asp Leu Ser Gly
1625 1630 1635

Tyr Glu Ala Ala Leu Val Lys Ala Gln Lys Leu Thr Asp Lys Asp
1640 1645 1650

Asn Gln Glu Glu Val Ala Ser Val Gln Ala Ser Met Lys Tyr Ala
1655 1660 1665

Thr Asp Asn His Leu Leu Thr Glu Arg Met Val Glu Tyr Phe Ala
1670 1675 1680

Asp Tyr Leu Asn Gln Leu Lys Asp Ser Ala Thr Lys Pro Asp Ala
1685 1690 1695

Pro Thr Val Glu Lys Pro Glu Phe Lys Leu Arg Ser Leu Ala Ser
1700 1705 1710

Glu Gln Gly Lys Thr Pro Asp Tyr Lys Gln Glu Ile Ala Arg Pro
1715 1720 1725

Glu Thr Pro Glu Gln Ile Leu Pro Ala Thr Gly Glu Ser Gln Ser
1730 1735 1740

Asp Thr Ala Leu Ile Leu Ala Ser Val Ser Leu Ala Leu Ser Ala
1745 1750 1755

Leu Phe Val Val Lys Thr Lys Lys Asp
    1760   1765

<210> 237
<211> 232
<212> PRT
<213> Streptococcus pneumoniae

<400> 237

Met Arg Lys Phe Lys Ile Phe Leu Phe Ile Glu Ala Cys Leu Leu Thr
1   5   10   15

Gly Ala Leu Ile Leu Met Val Ser Glu His Phe Ser Arg Phe Leu Leu
            20   25   30

Ile Leu Phe Leu Phe Leu Leu Leu Ile Arg Tyr Tyr Thr Gly Lys Glu
        35   40   45

Gly Asn Asn Leu Leu Leu Val Ala Ala Thr Ile Leu Phe Phe Phe Ile
    50   55   60

Val Met Leu Asn Pro Phe Val Ile Leu Ala Ile Phe Val Ala Val Ile
65   70   75   80

Tyr Ser Leu Phe Leu Leu Tyr Pro Met Met Asn Gln Glu Lys Glu Gln
                85   90   95

Thr Asn Leu Val Phe Glu Glu Val Val Thr Val Lys Lys Glu Lys Asn
            100   105   110

Arg Trp Phe Gly Asn Leu His His Phe Ser Ser Tyr Gln Thr Cys Gln
        115   120   125

Phe Asp Asp Ile Asn Leu Phe Arg Phe Met Gly Lys Asp Thr Ile His
    130   135   140

Leu Glu Arg Val Ile Leu Thr Asn His Asp Asn Val Ile Ile Leu Arg
145   150   155   160

Lys Met Val Gly Thr Thr Lys Ile Ile Val Pro Val Asp Val Glu Val
                165   170   175

Ser Leu Ser Val Asn Cys Leu Tyr Gly Asp Leu Ile Phe Phe Asn Gln
180 185 190

Pro Lys Arg Ala Leu Arg Asn Glu His Tyr His Gln Glu Thr Lys Asp
195 200 205

Tyr Leu Lys Ser Asn Lys Ser Val Lys Ile Phe Leu Thr Thr Met Ile
210 215 220

Gly Asp Val Glu Val Val Arg Gly
225 230

<210> 238
<211> 79
<212> PRT
<213> Streptococcus pneumoniae

<400> 238

Met Lys Lys Thr Val Tyr Lys Lys Leu Gly Ile Ser Ile Ile Ala Ser
1 5 10 15

Thr Leu Leu Ala Ser Gln Leu Ser Thr Val Ser Ala Leu Ser Val Ile
20 25 30

Ser Ser Thr Gly Glu Glu Tyr Glu Val Ser Glu Thr Leu Glu Lys Gly
35 40 45

Pro Glu Ser Asn Asp Ser Ser Leu Ser Glu Ile Ser Pro Thr Tyr Gly
50 55 60

Ser Tyr Tyr Gln Lys Gln Ser Glu Val Leu Ser Val Met Met Ile
65 70 75

<210> 239
<211> 778
<212> PRT
<213> Streptococcus pneumoniae

<400> 239

Met Asn Lys Lys Ile Leu Glu Thr Leu Glu Phe Asp Lys Val Lys Ala
1 5 10 15

Leu Phe Glu Pro His Leu Leu Thr Glu Gln Gly Leu Glu Gln Leu Arg
20 25 30

Gln Leu Ala Pro Thr Ala Lys Ala Asp Lys Ile Lys Gln Ala Phe Ala
35 40 45

Glu Met Lys Glu Met Gln Ala Leu Phe Val Glu Gln Pro His Phe Thr
50 55 60

Ile Leu Ser Thr Lys Glu Ile Ala Gly Val Cys Lys Arg Leu Glu Met
65 70 75 80

Gly Ala Asp Leu Asn Ile Glu Glu Phe Leu Leu Leu Lys Arg Val Leu
85 90 95

Leu Ala Ser Arg Glu Leu Gln Asn Phe Tyr Thr Asn Leu Glu Asn Val
100 105 110

Ser Leu Glu Glu Leu Ala Leu Trp Phe Glu Lys Leu His Asp Phe Pro
115 120 125

Gln Leu Gln Gly Asn Leu Gln Ala Phe Asn Asp Ala Gly Phe Ile Glu
130 135 140

Asn Phe Ala Ser Glu Glu Leu Ala Arg Ile Arg Arg Lys Ile His Asp
145 150 155 160

Ser Glu Ser Gln Val Arg Asp Val Leu Gln Asp Leu Leu Lys Gln Lys
165 170 175

Ala Gln Leu Leu Thr Glu Gly Ile Val Ala Ser Arg Asn Gly Arg Gln
180 185 190

Val Leu Pro Val Lys Asn Thr Tyr Arg Asn Lys Ile Ala Gly Val Val
195 200 205

His Asp Ile Ser Ala Ser Gly Asn Thr Val Tyr Ile Glu Pro Arg Glu
210 215 220

Val Val Lys Leu Ser Glu Glu Ile Ala Ser Leu Arg Ala Asp Glu Arg
225 230 235 240

Tyr Glu Met Leu Arg Ile Leu Gln Glu Ile Ser Glu Arg Val Arg Pro
245 250 255

His Ala Ala Glu Ile Ala Asn Asp Ala Trp Ile Ile Gly His Leu Asp
260 265 270

Leu Ile Arg Ala Lys Val Arg Phe Ile Gln Glu Arg Gln Ala Val Val
275 280 285

Pro Gln Leu Ser Glu Asn Gln Glu Ile Gln Leu Leu His Val Cys His
290 295 300

Pro Leu Val Lys Asn Ala Val Ala Asn Asp Val Tyr Phe Gly Gln Asp
305 310 315 320

Leu Thr Ala Ile Val Ile Thr Gly Pro Asn Thr Gly Gly Lys Thr Ile
325 330 335

Met Leu Lys Thr Leu Gly Leu Thr Gln Val Met Ala Gln Ser Gly Leu
340 345 350

Pro Ile Leu Ala Asp Lys Gly Ser Arg Val Gly Ile Phe Glu Glu Ile
355 360 365

Phe Ala Asp Ile Gly Asp Glu Gln Ser Ile Glu Gln Ser Leu Ser Thr
370 375 380

Phe Ser Ser His Met Thr Asn Ile Val Asp Ile Leu Gly Lys Val Asn
385 390 395 400

Gln His Ser Leu Leu Leu Leu Asp Glu Leu Gly Ala Gly Thr Asp Pro
405 410 415

Gln Glu Gly Ala Ala Leu Ala Met Ala Ile Leu Glu Asp Leu Arg Leu
420 425 430

Arg Gln Ile Lys Thr Met Ala Thr Thr His Tyr Pro Glu Leu Lys Ala
435 440 445

Tyr Gly Ile Glu Thr Ala Phe Val Gln Asn Ala Ser Met Glu Phe Asp
450 455 460

Thr Ala Thr Leu Arg Pro Thr Tyr Arg Phe Met Gln Gly Val Pro Gly
465 470 475 480

Arg Ser Asn Ala Phe Glu Ile Ala Lys Arg Leu Gly Leu Ser Glu Val
485 490 495

Ile Val Gly Asp Ala Ser Gln Gln Ile Asp Gln Asp Asn Asp Val Asn
500 505 510

Arg Ile Ile Glu Gln Leu Glu Glu Gln Thr Leu Glu Ser Arg Lys Arg
515 520 525

Leu Asp Asn Ile Arg Glu Val Glu Gln Glu Asn Leu Lys Met Asn Arg
530 535 540

Ala Leu Lys Lys Leu Tyr Asn Glu Leu Asn Arg Glu Lys Glu Thr Glu
545 550 555 560

Leu Asn Lys Ala Arg Glu Gln Ala Ala Glu Ile Val Asp Met Ala Leu
565 570 575

Ser Glu Ser Asp Gln Ile Leu Lys Asn Leu His Ser Lys Ser Gln Leu
580 585 590

Lys Pro His Glu Ile Ile Glu Ala Lys Ala Lys Leu Lys Lys Leu Ala
595 600 605

Pro Glu Lys Val Asp Leu Ser Lys Asn Lys Val Leu Gln Lys Ala Lys
610 615 620

Lys Lys Arg Ala Pro Lys Val Gly Asp Asp Ile Val Val Leu Ser Tyr
625 630 635 640

Gly Gln Arg Gly Thr Leu Thr Ser Gln Leu Lys Asp Gly Arg Trp Glu
645 650 655

Ala Gln Val Gly Leu Ile Lys Met Thr Leu Glu Glu Lys Glu Phe Asp
660 665 670

Leu Val Gln Ala Gln Gln Glu Lys Pro Val Lys Lys Lys Gln Val Asn

675 680 685

Val Val Lys Arg Thr Ser Gly Arg Gly Pro Gln Ala Arg Leu Asp Leu
690 695 700

Arg Gly Lys Arg Tyr Glu Glu Ala Met Asn Glu Leu Asp Thr Phe Ile
705 710 715 720

Asp Gln Ala Leu Leu Asn Asn Met Ala Gln Val Asp Ile Ile His Gly
725 730 735

Ile Gly Thr Gly Val Ile Arg Glu Gly Val Thr Lys Tyr Leu Gln Arg
740 745 750

Asn Lys His Val Lys Ser Phe Gly Tyr Ala Pro Gln Asn Ala Gly Gly
755 760 765

Ser Gly Ala Thr Ile Val Thr Phe Lys Gly
770 775

<210> 240
<211> 91
<212> PRT
<213> Streptococcus pneumoniae

<400> 240

Met Ser Phe Leu Asp Lys Ser Asn Leu Gly Thr Asn Gln Val Gln Met
1 5 10 15

Thr Asp Asn Pro Ser Val Ile Ser Asn Leu Ser Arg Met Arg Ala Asp
20 25 30

Thr Leu Arg Asn Phe Leu Glu Asn Ala Lys His Phe Ile Ala Leu Ile
35 40 45

Cys Ser Gln Thr Ser Asn Phe Phe Ala Gln Phe Asp Tyr Leu Thr Gly
50 55 60

Phe Asp Ile Asp Gly Val Ser Thr Ser Arg Asn Ile Met Asn Asp Thr
65 70 75 80

Cys Asn Leu Ile Ala Val Gly Val Phe Asp Trp

85 90

<210> 241
<211> 303
<212> PRT
<213> Streptococcus pneumoniae

<400> 241

Met Glu Val Arg Met Lys Lys Leu Pro Leu Val Phe Ser Gly Cys Leu
1 5 10 15

Leu Gly Leu Ala Gly Ala Gly Asn Leu Ile Leu Asp Thr Leu Pro Val
20 25 30

Leu Ser His Leu Phe Ser Leu Ile Gly Leu Val Leu Trp Ile Tyr Phe
35 40 45

Leu Ile Leu His Leu Phe Asn Trp Lys Glu Thr Lys Gln Glu Leu Thr
50 55 60

Lys Pro Pro Leu Leu Ser Gly Met Ala Thr Phe Pro Met Ala Gly Met
65 70 75 80

Ile Leu Ser Thr Tyr Val Phe Arg Val Phe Ser Tyr Leu Pro Leu Val
85 90 95

Ala Gln Gly Ile Trp Trp Phe Ser Phe Leu Leu Asp Leu Thr Leu Ile
100 105 110

Ala Gly Phe Thr Ile Lys Phe Ala Cys Pro Gly Arg Arg Val His Ala
115 120 125

Thr Pro Ser Trp Thr Val Leu Tyr Val Gly Ile Ala Val Ala Ala Leu
130 135 140

Thr Tyr Pro Leu Val Gly Ile Ile Glu Ile Ala Tyr Ala Thr Leu Ser
145 150 155 160

Phe Gly Phe Leu Leu Thr Phe Tyr Leu Tyr Pro Leu Ile Tyr Ser Asp
165 170 175

Leu Lys Lys His Pro Leu Pro Leu Ala Leu Leu Gly Gln Glu Gly Ile

180 185 190

Tyr Cys Ala Pro Phe Ser Leu Leu Leu Ala Ser Leu Val Arg Val Gly
195 200 205

Gly Thr Ser Leu Pro Thr Trp Val Leu Ile Val Met Ile Leu Ala Ser
210 215 220

Gln Ser Phe Phe Phe Phe Val Leu Thr Arg Leu Pro Asn Ile Leu Lys
225 230 235 240

Gln Gly Phe Gln Pro Ala Phe Ser Ala Leu Thr Phe Pro Thr Ile Ile
245 250 255

Thr Ala Thr Ser Leu Lys Met Ala Gln Gly Ile Leu Lys Leu Pro Phe
260 265 270

Leu Asp Tyr Leu Val Leu Ala Glu Thr Ile Ile Cys Leu Thr Ile Leu
275 280 285

Phe Phe Val Leu Gly Ala Tyr Leu Ile Trp Leu Arg Lys Lys Val
290 295 300

<210> 242
<211> 281
<212> PRT
<213> Streptococcus pneumoniae

<400> 242

Met Tyr Leu Ile Glu Ile Leu Lys Ser Ile Phe Phe Gly Ile Val Glu
1 5 10 15

Gly Ile Thr Glu Trp Leu Pro Ile Ser Ser Thr Gly His Leu Ile Leu
20 25 30

Ala Glu Glu Phe Ile Gln Tyr Gln Asn Gln Asn Glu Ala Phe Met Ser
35 40 45

Met Phe Asn Val Val Ile Gln Leu Gly Ala Ile Leu Ala Val Met Val
50 55 60

Ile Tyr Phe Asn Lys Leu Asn Pro Phe Lys Pro Thr Lys Asp Lys Gln

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65                  70                  75                  80

Glu Val Arg Lys Thr Trp Arg Leu Trp Leu Lys Val Leu Ile Ala Thr
                85                  90                  95

Leu Pro Leu Leu Gly Val Phe Lys Phe Asp Asp Trp Phe Asp Thr His
            100                 105                 110

Phe His Asn Met Val Ser Val Ala Leu Met Leu Ile Ile Tyr Gly Val
        115                 120                 125

Ala Phe Ile Tyr Leu Glu Lys Arg Asn Lys Ala Arg Ala Ile Glu Pro
    130                 135                 140

Ser Val Thr Glu Leu Asp Lys Leu Pro Tyr Thr Thr Ala Phe Tyr Ile
145                 150                 155                 160

Gly Leu Phe Gln Val Leu Ala Leu Leu Pro Gly Thr Ser Arg Ser Gly
                165                 170                 175

Ala Thr Ile Val Gly Gly Leu Leu Asn Gly Thr Ser Arg Ser Val Val
            180                 185                 190

Thr Glu Phe Thr Phe Tyr Leu Gly Ile Pro Val Met Phe Gly Ala Ser
        195                 200                 205

Ala Leu Lys Ile Phe Lys Phe Val Lys Ala Gly Glu Leu Leu Ser Phe
    210                 215                 220

Gly Gln Leu Phe Leu Leu Leu Val Ala Met Gly Val Ala Phe Ala Val
225                 230                 235                 240

Ser Met Val Ala Ile Arg Phe Leu Thr Ser Tyr Val Lys Lys His Asp
                245                 250                 255

Phe Thr Leu Phe Gly Lys Tyr Arg Ile Val Leu Gly Ser Val Leu Leu
            260                 265                 270

Leu Tyr Ser Phe Val Arg Leu Phe Val
        275                 280
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<210> 243
<211> 304
<212> PRT
<213> Streptococcus pneumoniae

<400> 243

Met Leu Ile Lys Met Val Lys Thr Lys Lys Gln Lys Arg Asn Asn Leu
1 5 10 15

Leu Leu Gly Val Val Phe Phe Ile Gly Met Ala Val Met Ala Tyr Pro
20 25 30

Leu Val Ser Arg Leu Tyr Tyr Arg Val Glu Ser Asn Gln Gln Ile Ala
35 40 45

Asp Phe Asp Lys Glu Lys Ala Thr Leu Asp Glu Ala Asp Ile Asp Glu
50 55 60

Arg Met Lys Leu Ala Gln Ala Phe Asn Asp Ser Leu Asn Asn Val Val
65 70 75 80

Ser Gly Asp Pro Trp Ser Glu Glu Met Lys Lys Lys Gly Arg Ala Glu
85 90 95

Tyr Ala Arg Met Leu Glu Ile His Glu Arg Met Gly His Val Glu Ile
100 105 110

Pro Val Ile Asp Val Asp Leu Pro Val Tyr Ala Gly Thr Ala Glu Glu
115 120 125

Val Leu Gln Gln Gly Ala Gly His Leu Glu Gly Thr Ser Leu Pro Ile
130 135 140

Gly Gly Asn Ser Thr His Ala Val Ile Thr Ala His Thr Gly Leu Pro
145 150 155 160

Thr Ala Lys Met Phe Thr Asp Leu Thr Lys Leu Lys Val Gly Asp Lys
165 170 175

Phe Tyr Val His Asn Ile Lys Glu Val Met Ala Tyr Gln Val Asp Gln
180 185 190

Val Lys Val Ile Glu Pro Thr Asn Phe Asp Asp Leu Leu Ile Val Pro
195 200 205

Gly His Asp Tyr Val Thr Leu Leu Thr Cys Thr Pro Tyr Met Ile Asn
210 215 220

Thr His Arg Leu Leu Val Arg Gly His Arg Ile Pro Tyr Val Ala Glu
225 230 235 240

Val Glu Glu Glu Phe Ile Ala Ala Asn Lys Leu Ser His Leu Tyr Arg
245 250 255

Tyr Leu Phe Tyr Val Ala Val Gly Leu Ile Val Ile Leu Leu Trp Ile
260 265 270

Ile Arg Arg Leu Arg Lys Lys Lys Lys Gln Pro Glu Lys Ala Leu Lys
275 280 285

Ala Leu Lys Ala Ala Arg Lys Glu Val Lys Val Glu Asp Gly Gln Gln
290 295 300

<210> 244
<211> 297
<212> PRT
<213> Streptococcus pneumoniae

<400> 244

Met Asp Asn Ser Arg Arg Ser Arg Lys Lys Gly Thr Lys Lys Lys Lys
1 5 10 15

His Pro Leu Ile Leu Leu Leu Ile Phe Leu Val Gly Phe Ala Val Ala
20 25 30

Ile Tyr Pro Leu Val Ser Arg Tyr Tyr Tyr Arg Ile Glu Ser Asn Glu
35 40 45

Val Ile Lys Glu Phe Asp Glu Thr Val Ser Gln Met Asp Lys Ala Glu
50 55 60

Leu Glu Glu Arg Trp Arg Leu Ala Gln Ala Phe Asn Ala Thr Leu Lys
65 70 75 80

Pro Ser Glu Ile Leu Asp Pro Phe Thr Glu Gln Glu Lys Lys Lys Gly
85 90 95

Val Ser Glu Tyr Ala Asn Met Leu Lys Val His Glu Arg Ile Gly Tyr
100 105 110

Val Glu Ile Pro Ala Ile Asp Gln Glu Ile Pro Met Tyr Val Gly Thr
115 120 125

Ser Glu Asp Ile Leu Gln Lys Gly Ala Gly Leu Leu Glu Gly Ala Ser
130 135 140

Leu Pro Val Gly Gly Glu Asn Thr His Thr Val Ile Thr Ala His Arg
145 150 155 160

Gly Leu Pro Thr Ala Glu Leu Phe Ser Gln Leu Asp Lys Met Lys Lys
165 170 175

Gly Asp Ile Phe Tyr Leu His Val Leu Asp Gln Val Leu Ala Tyr Gln
180 185 190

Val Asp Gln Ile Val Thr Val Glu Pro Asn Asp Phe Glu Pro Val Leu
195 200 205

Ile Gln His Gly Glu Asp Tyr Ala Thr Leu Leu Thr Cys Thr Pro Tyr
210 215 220

Met Ile Asn Ser His Arg Leu Leu Val Arg Gly Lys Arg Ile Pro Tyr
225 230 235 240

Thr Ala Pro Ile Ala Glu Arg Asn Arg Ala Val Arg Glu Arg Gly Gln
245 250 255

Phe Trp Leu Trp Leu Leu Leu Gly Ala Met Ala Val Ile Leu Leu Leu
260 265 270

Leu Tyr Arg Val Tyr Arg Asn Arg Arg Ile Val Lys Gly Leu Glu Lys
275 280 285

Gln Leu Glu Gly Arg His Val Lys Asp
290 295

<210> 245
<211> 441
<212> PRT
<213> Streptococcus pneumoniae

<400> 245

Met Met Asn Asn Ile Leu Ala Phe Leu Glu Thr Lys Val Ala Pro Phe
1 5 10 15

Gly Glu Lys Val Gly Asn Gln Arg His Leu Lys Ala Ile Arg Glu Gly
20 25 30

Phe Met Met Ala Met Pro Leu Ile Leu Val Gly Ser Leu Phe Leu Ile
35 40 45

Leu Ile Ser Trp Pro Gln Glu Ala Phe Thr Asn Trp Leu Asn Ser Val
50 55 60

Gly Leu Leu Ser Ile Leu Thr Thr Met Asn Gln Ser Thr Val Ala Ile
65 70 75 80

Ile Ser Leu Val Ala Cys Phe Gly Ile Ala Tyr Arg Leu Ser Glu Gly
85 90 95

Tyr Gly Thr Asp Gly Pro Ser Ala Gly Ile Ile Ala Leu Ser Ser Phe
100 105 110

Val Leu Met Ala Pro Arg Phe Ser Ser Met Val Tyr Asp Lys Asn Gly
115 120 125

Glu Gln Val Lys Gln Leu Phe Gly Gly Ala Ile Pro Phe Ser Ser Leu
130 135 140

Asn Ala Ser Ser Leu Phe Met Ala Ile Thr Ile Gly Leu Val Thr Ala
145 150 155 160

Glu Ile Tyr Arg Met Phe Ile Gln Arg Gly Ile Thr Ile Lys Met Pro
165 170 175

Ser Gly Val Pro Asp Val Val Ser Lys Ser Phe Ser Ala Leu Leu Ser
180 185 190

```
Gly Phe Thr Thr Phe Val Leu Trp Ala Leu Val Leu Lys Gly Leu Glu
        195                 200                 205

Ala Ala Gly Val Ala Gly Gly Leu Asn Gly Leu Leu Gly Ala Ile Val
    210                 215                 220

Gly Thr Pro Leu Lys Leu Ile Ala Gly Thr Leu Pro Gly Met Ile Leu
225                 230                 235                 240

Cys Val Ile Val Asn Ser Phe Phe Trp Phe Cys Gly Val Asn Gly Gly
                245                 250                 255

Gln Val Leu Asn Ala Phe Val Asp Pro Val Trp Leu Gln Phe Thr Thr
            260                 265                 270

Glu Asn Gln Glu Ala Val Ala Ala Gly Gln Thr Leu Gln His Ile Ile
        275                 280                 285

Thr Leu Pro Phe Lys Asp Leu Phe Val Phe Ile Gly Gly Gly Gly Ala
    290                 295                 300

Thr Ile Gly Leu Ala Ile Cys Leu Phe Leu Phe Ser Lys Ser Arg Ala
305                 310                 315                 320

Asn Lys Thr Leu Gly Lys Leu Ala Ile Ile Pro Ser Ile Phe Asn Ile
                325                 330                 335

Asn Thr Ala Ile Leu Phe Thr Phe Pro Thr Val Leu Asn Pro Ile Met
            340                 345                 350

Leu Ile Pro Phe Ile Ala Thr Pro Thr Ile Asn Ala Leu Ile Thr Tyr
        355                 360                 365

Val Ser Met Ala Val Gly Leu Val Pro Tyr Thr Thr Gly Val Ile Leu
    370                 375                 380

Pro Trp Thr Met Pro Pro Ile Ile Gly Gly Phe Leu Ala Thr Gly Ala
385                 390                 395                 400

Ser Trp Arg Gly Ala Leu Leu Gln Val Val Leu Ile Leu Val Ser Val
                405                 410                 415
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Ala Ile Tyr Tyr Pro Phe Phe Lys Ile Ala Asp Lys Arg Asn Leu Glu
420 425 430

Lys Glu Lys Ala Thr Val Gly Gly Lys
435 440

<210> 246
<211> 559
<212> PRT
<213> Streptococcus pneumoniae

<400> 246

Met Asp Lys Leu Val Ala Ala Ile Glu Lys Gln Gln Gly Lys Phe Glu
1 5 10 15

Lys Ile Ser Thr Asn Asn Tyr Met Met Ala Ile Lys Asp Gly Phe Ile
20 25 30

Ala Thr Met Pro Leu Ile Met Phe Ser Ser Phe Leu Met Ile Ile Ile
35 40 45

Met Ile Pro Lys Asn Phe Gly Val Glu Leu Pro Ser Pro Ala Ile Val
50 55 60

Trp Met Arg Lys Val Tyr Met Leu Thr Met Gly Val Leu Gly Ile Ile
65 70 75 80

Val Ser Gly Thr Val Gly Lys Ser Leu Val Gly Asn Val Asn Arg Lys
85 90 95

Met Pro His Gly Lys Val Ile Asn Asp Ile Ser Ala Met Leu Ala Ala
100 105 110

Ile Cys Ser Tyr Leu Val Leu Thr Val Thr Leu Val Val Asp Glu Lys
115 120 125

Thr Gly Ser Thr Ser Leu Ser Thr Asn Tyr Leu Gly Ser Gln Gly Leu
130 135 140

Ile Thr Ser Phe Val Ser Ala Phe Ile Thr Val Asn Val Tyr Arg Phe
145 150 155 160

Cys Ile Lys Arg Asp Ile Thr Ile His Leu Pro Lys Glu Val Pro Gly
165 170 175

Ala Ile Ser Gln Ala Phe Arg Asp Ile Phe Pro Phe Ser Phe Val Leu
180 185 190

Leu Ile Ser Gly Leu Leu Asp Ile Val Ser Arg Phe Ser Leu Asp Val
195 200 205

Pro Phe Ala Gln Val Phe Gln Gln Leu Leu Thr Pro Ile Phe Lys Gly
210 215 220

Ala Glu Ser Tyr Pro Ala Met Met Leu Ile Trp Phe Met Cys Ala Leu
225 230 235 240

Leu Trp Phe Val Gly Ile His Gly Pro Ser Ile Val Leu Pro Ala Val
245 250 255

Thr Ala Leu Gln Leu Ser Asn Met Glu Glu Asn Ala Gln Leu Leu Ala
260 265 270

Asn Gly Gln Phe Pro Tyr His Ser Leu Thr Pro Asn Phe Gly Asn Tyr
275 280 285

Ile Ala Ala Ile Gly Gly Thr Gly Ala Thr Phe Val Val Pro Phe Ile
290 295 300

Leu Ile Phe Phe Met Arg Ser Lys Gln Leu Lys Ser Val Gly Lys Ala
305 310 315 320

Thr Ile Thr Pro Val Leu Phe Ala Val Asn Glu Pro Leu Leu Phe Gly
325 330 335

Met Pro Val Ile Leu Asn Pro Tyr Leu Phe Val Pro Phe Leu Met Thr
340 345 350

Pro Pro Val Asn Val Phe Leu Gly Lys Val Phe Ile Asp Phe Phe Gly
355 360 365

Met Asn Gly Phe Tyr Ile Gln Leu Pro Trp Thr Phe Pro Gly Pro Leu

370 375 380

Gly Leu Leu Ile Gly Thr Asn Phe Gln Leu Ile Ser Phe Val Phe Leu
385 390 395 400

Ser Leu Ile Leu Val Val Asp Ile Leu Ile Tyr Leu Pro Phe Cys Arg
405 410 415

Ala Tyr Asp Arg Gln Leu Leu Val Lys Glu Asp Ile Ala Ser Ser Asn
420 425 430

Asp Ile Ile Leu Glu Glu Asp Thr Ser Glu Ile Ile Pro Gly Glu Ile
435 440 445

Asp Glu Ile Lys Ser Lys Glu Leu Lys Val Leu Val Leu Cys Ala Gly
450 455 460

Ser Gly Thr Ser Ala Gln Leu Ala Asn Ala Ile Asn Glu Gly Ala Asn
465 470 475 480

Leu Thr Glu Val Arg Val Ile Ala Asn Ser Gly Ala Tyr Gly Ala His
485 490 495

Tyr Asp Ile Met Gly Val Tyr Asp Leu Ile Ile Leu Ala Pro Gln Val
500 505 510

Arg Ser Tyr Tyr Arg Glu Met Lys Val Asp Ala Glu Arg Leu Gly Ile
515 520 525

Gln Ile Val Ala Thr Arg Gly Met Glu Tyr Ile His Leu Thr Lys Ser
530 535 540

Pro Ser Lys Ala Leu Gln Phe Val Leu Glu His Tyr Gln Ala Val
545 550 555

<210> 247
<211> 560
<212> PRT
<213> Streptococcus pneumoniae

<400> 247

Met Lys Glu Ala Ile Ile Glu Trp Lys Asp Phe Ser Phe Arg Tyr Glu

1 5 10 15

Thr Gln Gln Glu Pro Thr Leu Gln Gly Ile Asp Leu Thr Ile Tyr Lys
20 25 30

Gly Glu Lys Val Leu Ile Val Gly Pro Ser Gly Ser Gly Lys Ser Thr
35 40 45

Leu Gly Gln Cys Leu Asn Gly Ile Ile Pro Asn Ile Tyr Lys Gly Gln
50 55 60

Thr Tyr Gly Glu Phe Leu Ile Lys Gly Gln Val Ala Phe Asp Met Ser
65 70 75 80

Ile Tyr Asp Lys Ser His Leu Val Ser Thr Val Leu Gln Asp Thr Asp
85 90 95

Gly Gln Phe Ile Gly Leu Ser Val Ala Glu Asp Leu Ala Phe Ala Leu
100 105 110

Glu Asn Asp Val Thr Ala Leu Asp Glu Met Lys Gly Arg Val Tyr Lys
115 120 125

Trp Ala Glu Lys Leu Asp Leu Leu Pro Leu Leu Asp Gln Arg Pro Gln
130 135 140

Asp Leu Ser Gly Gly Gln Lys Gln Arg Val Ser Leu Ala Gly Val Leu
145 150 155 160

Ile Asp Glu Ser Pro Ile Leu Leu Phe Asp Glu Pro Leu Ala Asn Leu
165 170 175

Asp Pro Lys Ser Gly Gln Asp Ile Ile Glu Leu Ile Asp Gln Ile His
180 185 190

Lys Glu Glu Gly Thr Thr Thr Leu Ile Ile Glu His Arg Leu Glu Asp
195 200 205

Val Leu His Arg Pro Val Asp Arg Ile Val Leu Ile Asn Asp Gly Arg
210 215 220

Ile Leu Phe Asn Gly Ser Pro Asp Gln Leu Leu Ala Thr Asp Leu Leu
225 230 235 240

Thr Gln Asn Gly Ile Arg Glu Pro Leu Tyr Leu Thr Thr Leu Arg Gln
245 250 255

Leu Gly Val Asp Leu Val Lys Glu Glu Gln Leu Ala Asn Leu Asp Asn
260 265 270

Leu Ser Ile Ser Lys Gly Gln Val Gln Leu Gln Asn Glu Leu Ala Lys
275 280 285

Glu Thr Pro Ala Leu Gln Ser Leu Phe Arg Leu Glu Glu Val Ser Phe
290 295 300

Ser Tyr Asp Asp Arg Pro Ile Leu Lys Ser Leu His Leu Asp Ile Lys
305 310 315 320

Lys Gly Glu Lys Ile Ala Ile Val Gly Lys Asn Gly Ala Gly Lys Ser
325 330 335

Thr Leu Ala Lys Ala Ile Ser Ser Phe Ile Gln Thr Glu Gly Arg Tyr
340 345 350

Leu Trp Glu Lys Gln Asp Ile Lys Gly Asp Ser Val Ala Glu Arg Ala
355 360 365

Glu Arg Val Gly Tyr Val Leu Gln Asn Pro Asn Gln Met Ile Ser Thr
370 375 380

Asn Met Ile Phe Asp Glu Val Ala Leu Gly Leu Arg Leu Arg Gly Val
385 390 395 400

Asp Glu Lys Glu Ile Glu Thr Arg Val Tyr Glu Thr Leu Lys Ile Cys
405 410 415

Gly Leu Tyr Glu Phe Arg Asn Trp Pro Ile Ser Ala Leu Ser Phe Gly
420 425 430

Gln Lys Lys Arg Val Thr Ile Ala Ser Ile Leu Val Leu Gly Ala Glu
435 440 445

Ile Ile Leu Leu Asp Glu Pro Thr Ala Gly Gln Asp Gln Lys Asn Tyr
450 455 460

Thr Glu Ile Met Glu Phe Leu Glu Glu Leu His Gln Lys Gly His Thr
465 470 475 480

Ile Val Met Ile Thr His Asp Met Gln Leu Met Leu Asp Tyr Ser Asp
485 490 495

Arg Val Leu Val Met Val Asp Gly Glu Leu Ile Ala Asp Thr Val Pro
500 505 510

Ala Ser Leu Leu Ser Asp Pro Glu Leu Leu Val Lys Ala Asn Leu Lys
515 520 525

Glu Thr Ser Ile Phe Asn Leu Ala Lys Lys Leu Asp Val Asp Pro Leu
530 535 540

Asp Leu Thr Ala Phe Tyr Lys Glu Arg Arg Glu Gly Cys Lys Leu Asn
545 550 555 560

<210> 248
<211> 543
<212> PRT
<213> Streptococcus pneumoniae

<400> 248

Met Ser Ile Asn Trp Gln Glu Ile Leu Phe His Phe Leu Gly Gly Leu
1 5 10 15

Gly Leu Phe Leu Tyr Ser Ile Lys Thr Met Gly Asp Gly Leu Gln Gln
20 25 30

Ala Ala Gly Asp Arg Leu Arg Phe Tyr Ile Asp Lys Tyr Thr Ser Asn
35 40 45

Pro Phe Phe Gly Val Leu Val Gly Ile Gly Met Thr Ala Leu Ile Gln
50 55 60

Ser Ser Ser Gly Val Thr Val Ile Thr Val Gly Leu Val Ser Ala Gly
65 70 75 80

Leu Leu Thr Leu Arg Gln Ala Ile Gly Ile Val Met Gly Ala Asn Ile
85 90 95

Gly Thr Thr Val Thr Ser Phe Leu Ile Gly Phe Lys Leu Gly Asn Tyr
100 105 110

Ala Leu Pro Met Leu Phe Ile Gly Ala Val Cys Leu Phe Phe Thr Lys
115 120 125

Asn Arg Thr Val Asn Asn Ile Gly Arg Ile Leu Phe Gly Val Gly Gly
130 135 140

Ile Phe Phe Ala Leu Asn Leu Met Ser Gly Ala Met Ala Pro Leu Lys
145 150 155 160

Asp Leu Gln Val Phe Lys Asp Tyr Met Ile Glu Leu Ser Lys Asn Pro
165 170 175

Val Leu Gly Val Phe Val Gly Thr Gly Leu Thr Leu Leu Ile Gln Ala
180 185 190

Ser Ser Ala Thr Ile Gly Ile Leu Gln Asn Leu Tyr Ala Gly Asn Leu
195 200 205

Ile Asp Leu Gln Gly Ala Leu Pro Val Leu Phe Gly Asp Asn Ile Gly
210 215 220

Thr Thr Ile Thr Ala Ile Ile Ala Ser Leu Gly Ala Asn Ile Ala Ala
225 230 235 240

Lys Arg Val Ala Gly Ala His Val Ala Phe Asn Val Ile Gly Thr Val
245 250 255

Val Cys Val Ile Phe Leu Val Pro Phe Thr Val Leu Ile His Trp Phe
260 265 270

Glu Ala Thr Leu Asn Leu Ala Pro Glu Met Thr Ile Ala Phe Ala His
275 280 285

Gly Thr Phe Asn Ile Thr Asn Thr Ile Val Gln Phe Pro Phe Ile Gly
290 295 300

Ala Leu Ala Tyr Phe Val Thr Lys Ile Ile Pro Gly Glu Asp Glu Val
305 310 315 320

Val Lys Tyr Glu Pro Leu Tyr Leu Asp Glu His Phe Ile Lys Gln Ala
325 330 335

Pro Ser Ile Ala Leu Gly Asn Ala Lys Lys Glu Leu Leu His Leu Gly
340 345 350

Asn Tyr Ala Ala Lys Ala Phe Asp Leu Ser Tyr Lys Tyr Ile Ile Asp
355 360 365

Leu Asp Glu Lys Val Ala Glu Lys Gly His Lys Thr Glu Glu Ala Ile
370 375 380

Asn Thr Ile Asp Glu Gln Leu Thr Arg Tyr Leu Ile Ala Leu Ser Ser
385 390 395 400

Glu Ala Leu Ser Gln Lys Glu Ser Glu Val Leu Thr Asn Ile Leu Asp
405 410 415

Ser Ser Arg Asp Leu Glu Arg Ile Gly Asp His Thr Glu Ala Leu Leu
420 425 430

Asn Leu Thr Asp Tyr Leu Gln Arg Lys Asn Val Glu Phe Ser Asp Ala
435 440 445

Ala Leu Lys Glu Leu Glu Glu Val Tyr Arg Gln Thr Ser Asp Phe Ile
450 455 460

Lys Asp Ala Leu Asp Ser Val Glu Asn Asn Asp Ile Glu Lys Ala Arg
465 470 475 480

Ser Leu Val Glu Arg His Glu Ala Ile Asn Lys Ile Glu Arg Val Leu
485 490 495

Arg Lys Thr His Ile Lys Arg Leu Asn Lys Gly Glu Cys Ser Thr Gln
500 505 510

Ala Gly Val Asn Phe Ile Asp Ile Ile Ser His Tyr Thr Arg Val Ser

515 520 525

Asp His Ala Met Asn Leu Ala Glu Lys Val Phe Ala Glu Gln Ile
530 535 540

<210> 249
<211> 1659
<212> PRT
<213> Streptococcus pneumoniae

<400> 249

Met Lys Asn Pro Phe Phe Glu Arg Arg Cys Arg Tyr Ser Ile Arg Lys
1 5 10 15

Leu Ser Val Gly Ala Cys Ser Leu Met Ile Gly Ala Val Leu Phe Ala
20 25 30

Gly Pro Ala Leu Ala Glu Glu Thr Ala Val Pro Glu Asn Ser Gly Ala
35 40 45

Asn Thr Glu Leu Val Ser Gly Glu Ser Glu His Ser Thr Asn Glu Ala
50 55 60

Asp Lys Gln Asn Glu Gly Glu His Ala Arg Glu Asn Lys Leu Glu Lys
65 70 75 80

Ala Glu Gly Val Ala Ile Ala Ser Glu Thr Ala Ser Pro Ala Ser Asn
85 90 95

Glu Ala Ala Thr Thr Glu Thr Ala Glu Ala Ala Ser Ala Ala Lys Pro
100 105 110

Glu Glu Lys Ala Ser Glu Val Val Ala Glu Thr Pro Ser Ala Glu Ala
115 120 125

Lys Pro Lys Ser Asp Lys Glu Thr Glu Ala Lys Pro Glu Ala Thr Asn
130 135 140

Gln Gly Asp Glu Ser Lys Pro Ala Ala Glu Ala Asn Lys Thr Glu Lys
145 150 155 160

Glu Val Gln Pro Asp Val Pro Lys Asn Thr Glu Lys Thr Leu Lys Pro

165 170 175

Lys Glu Ile Lys Phe Asn Ser Trp Glu Glu Leu Leu Lys Trp Glu Pro
180 185 190

Gly Ala Arg Glu Asp Asp Ala Ile Asn Arg Gly Ser Val Val Leu Ala
195 200 205

Ser Arg Arg Thr Gly His Leu Val Asn Glu Lys Ala Ser Lys Glu Ala
210 215 220

Lys Val Gln Ala Leu Ser Asn Thr Asn Ser Lys Ala Lys Asp His Ala
225 230 235 240

Ser Val Gly Gly Glu Glu Phe Lys Ala Tyr Ala Phe Asp Tyr Trp Gln
245 250 255

Tyr Leu Asp Ser Met Val Phe Trp Glu Gly Leu Val Pro Thr Pro Asp
260 265 270

Val Ile Asp Ala Gly His Arg Asn Gly Val Pro Val Tyr Gly Thr Leu
275 280 285

Phe Phe Asn Trp Ser Asn Ser Ile Ala Asp Gln Glu Arg Phe Ala Glu
290 295 300

Ala Leu Lys Gln Asp Ala Asp Gly Ser Phe Pro Ile Ala Arg Lys Leu
305 310 315 320

Val Asp Met Ala Lys Tyr Tyr Gly Tyr Asp Gly Tyr Phe Ile Asn Gln
325 330 335

Glu Thr Thr Gly Asp Leu Val Lys Pro Leu Gly Glu Lys Met Arg Gln
340 345 350

Phe Met Leu Tyr Ser Lys Glu Tyr Ala Ala Lys Val Asn His Pro Ile
355 360 365

Lys Tyr Ser Trp Tyr Asp Ala Met Thr Tyr Asn Tyr Gly Arg Tyr His
370 375 380

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Gln Asp Gly Leu Gly Glu Tyr Asn Tyr Gln Phe Met Gln Pro Glu Gly
385                 390                 395                 400

Asp Lys Val Pro Ala Asp Asn Phe Phe Ala Asn Phe Asn Trp Asp Lys
                405                 410                 415

Ala Lys Asn Asp Tyr Thr Ile Ala Thr Ala Asn Trp Ile Gly Arg Asn
            420                 425                 430

Pro Tyr Asp Val Phe Ala Gly Leu Glu Leu Gln Gln Gly Gly Ser Tyr
        435                 440                 445

Lys Thr Lys Val Lys Trp Asn Asp Ile Leu Asp Glu Asn Gly Lys Leu
    450                 455                 460

Arg Leu Ser Leu Gly Leu Phe Ala Pro Asp Thr Ile Thr Ser Leu Gly
465                 470                 475                 480

Lys Thr Gly Glu Asp Tyr His Lys Asn Glu Asp Ile Phe Phe Thr Gly
                485                 490                 495

Tyr Gln Gly Asp Pro Thr Gly Gln Lys Pro Gly Asp Lys Asp Trp Tyr
            500                 505                 510

Gly Ile Ala Asn Leu Val Ala Asp Arg Thr Pro Ala Val Gly Asn Thr
        515                 520                 525

Phe Thr Thr Ser Phe Asn Thr Gly His Gly Lys Lys Trp Phe Val Asp
    530                 535                 540

Gly Lys Val Ser Lys Asp Ser Glu Trp Asn Tyr Arg Ser Val Ser Gly
545                 550                 555                 560

Val Leu Pro Thr Trp Arg Trp Trp Gln Thr Ser Thr Gly Glu Lys Leu
                565                 570                 575

Arg Ala Glu Tyr Asp Phe Thr Asp Ala Tyr Asn Gly Gly Asn Ser Leu
            580                 585                 590

Lys Phe Ser Gly Asp Val Ala Gly Lys Thr Asp Gln Asp Val Arg Leu
        595                 600                 605
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Tyr Ser Thr Lys Leu Glu Val Thr Glu Lys Thr Lys Leu Arg Val Ala
610 615 620

His Lys Gly Gly Lys Gly Ser Lys Val Tyr Met Ala Phe Ser Thr Thr
625 630 635 640

Pro Asp Tyr Lys Phe Asp Asp Ala Asp Ala Trp Lys Glu Leu Thr Leu
645 650 655

Ser Asp Asn Trp Thr Asn Glu Glu Phe Asp Leu Ser Ser Leu Ala Gly
660 665 670

Lys Thr Ile Tyr Ala Val Lys Leu Phe Phe Glu His Glu Gly Ala Val
675 680 685

Lys Asp Tyr Gln Phe Asn Leu Gly Gln Leu Thr Ile Ser Asp Asn His
690 695 700

Gln Glu Pro Gln Ser Pro Thr Ser Phe Ser Val Val Lys Gln Ser Leu
705 710 715 720

Lys Asn Ala Gln Glu Ala Glu Ala Val Val Gln Phe Lys Gly Asn Lys
725 730 735

Asp Ala Asp Phe Tyr Glu Val Tyr Glu Lys Asp Gly Asp Ser Trp Lys
740 745 750

Leu Leu Thr Gly Ser Ser Ser Thr Thr Ile Tyr Leu Pro Lys Val Ser
755 760 765

Arg Ser Ala Ser Ala Gln Gly Thr Thr Gln Glu Leu Lys Val Val Ala
770 775 780

Val Gly Lys Asn Gly Val Arg Ser Glu Ala Ala Thr Thr Thr Phe Asp
785 790 795 800

Trp Gly Met Thr Val Lys Asp Thr Ser Leu Pro Lys Pro Leu Ala Glu
805 810 815

Asn Ile Val Pro Gly Ala Thr Val Ile Asp Ser Thr Phe Pro Lys Thr
820 825 830

Glu Gly Gly Glu Gly Ile Glu Gly Met Leu Asn Gly Thr Ile Thr Ser
835 840 845

Leu Ser Asp Lys Trp Ser Ser Ala Gln Leu Ser Gly Ser Val Asp Ile
850 855 860

Arg Leu Thr Lys Pro Arg Thr Val Val Arg Trp Val Met Asp His Ala
865 870 875 880

Gly Ala Gly Gly Glu Ser Val Asn Asp Gly Leu Met Asn Thr Lys Asp
885 890 895

Phe Asp Leu Tyr Tyr Lys Asp Ala Asp Gly Glu Trp Lys Leu Ala Lys
900 905 910

Glu Val Arg Gly Asn Lys Ala His Val Thr Asp Ile Thr Leu Asp Lys
915 920 925

Pro Ile Thr Ala Gln Asp Trp Arg Leu Asn Val Val Thr Ser Asp Asn
930 935 940

Gly Thr Pro Trp Lys Ala Ile Arg Ile Tyr Asn Trp Lys Met Tyr Glu
945 950 955 960

Lys Leu Asp Thr Glu Ser Val Asn Ile Pro Met Ala Lys Ala Ala Ala
965 970 975

Arg Ser Leu Gly Asn Asn Lys Val Gln Val Gly Phe Ala Asp Val Pro
980 985 990

Ala Gly Ala Thr Ile Thr Val Tyr Asp Asn Pro Asn Ser Gln Thr Pro
995 1000 1005

Leu Ala Thr Leu Lys Ser Glu Val Gly Gly Asp Leu Ala Ser Ala
1010 1015 1020

Pro Leu Asp Leu Thr Asn Gln Ser Gly Leu Leu Tyr Tyr Arg Thr
1025 1030 1035

Gln Leu Pro Gly Lys Glu Ile Ser Asn Val Leu Ala Val Ser Val

1040 1045 1050

Pro Lys Asp Asp Arg Arg Ile Lys Ser Val Ser Leu Glu Thr Gly
1055 1060 1065

Pro Lys Lys Thr Ser Tyr Ala Glu Gly Glu Asp Leu Asp Leu Arg
1070 1075 1080

Gly Gly Val Leu Arg Val Gln Tyr Glu Gly Gly Thr Glu Asp Glu
1085 1090 1095

Leu Ile Arg Leu Thr His Ala Gly Val Ser Val Ser Gly Phe Asp
1100 1105 1110

Thr His His Lys Gly Glu Gln Asn Leu Thr Leu Gln Tyr Leu Gly
1115 1120 1125

Gln Pro Val Asn Ala Asn Leu Ser Val Thr Val Thr Gly Gln Asp
1130 1135 1140

Glu Ala Ser Pro Lys Thr Ile Leu Gly Ile Glu Val Ser Gln Glu
1145 1150 1155

Pro Lys Lys Asp Tyr Leu Val Gly Asp Ser Leu Asp Leu Ser Glu
1160 1165 1170

Gly Arg Phe Ala Val Ala Tyr Ser Asn Asp Thr Met Glu Glu His
1175 1180 1185

Ser Phe Thr Asp Glu Gly Val Glu Ile Ser Gly Tyr Asp Ala Gln
1190 1195 1200

Lys Thr Gly Arg Gln Thr Leu Thr Leu His Tyr Gln Gly His Glu
1205 1210 1215

Val Ser Phe Asp Val Leu Val Ser Pro Lys Ala Ala Leu Asn Asp
1220 1225 1230

Glu Tyr Leu Lys Gln Lys Leu Ala Glu Val Glu Ala Ala Lys Asn
1235 1240 1245

Lys Val Val Tyr Asn Phe Ala Ser Ser Glu Val Lys Glu Ala Phe
1250 1255 1260

Leu Lys Ala Ile Glu Ala Ala Glu Gln Val Leu Lys Asp His Glu
1265 1270 1275

Thr Ser Thr Gln Asp Gln Val Asn Asp Arg Leu Asn Lys Leu Thr
1280 1285 1290

Glu Ala His Lys Ala Leu Asn Gly Gln Glu Lys Phe Thr Glu Glu
1295 1300 1305

Lys Thr Glu Leu Asp Arg Leu Thr Gly Glu Val Gln Glu Leu Leu
1310 1315 1320

Ala Ala Lys Pro Asn His Pro Ser Gly Ser Ala Leu Ala Pro Leu
1325 1330 1335

Leu Glu Lys Asn Lys Ala Leu Val Glu Lys Val Asp Leu Ser Pro
1340 1345 1350

Glu Glu Leu Thr Thr Ala Lys Gln Ser Leu Lys Asp Leu Val Ala
1355 1360 1365

Leu Leu Lys Glu Asp Lys Pro Ala Val Phe Ser Asp Ser Lys Thr
1370 1375 1380

Gly Val Glu Val His Phe Ser Asn Lys Glu Lys Thr Val Ile Lys
1385 1390 1395

Gly Leu Lys Val Glu Arg Val Gln Ala Ser Ala Glu Glu Lys Lys
1400 1405 1410

Tyr Phe Ala Gly Glu Asp Ala His Val Phe Glu Ile Glu Gly Leu
1415 1420 1425

Asp Glu Lys Gly Gln Asp Val Asp Leu Ser Tyr Ala Ser Ile Val
1430 1435 1440

Lys Ile Pro Ile Glu Lys Asp Lys Lys Val Lys Lys Val Phe Phe
1445 1450 1455

Leu Pro Glu Gly Lys Glu Ala Val Glu Leu Ala Phe Glu Gln Thr
1460 1465 1470

Asp Ser His Val Ile Phe Thr Ala Pro His Phe Thr His Tyr Ala
1475 1480 1485

Phe Val Tyr Glu Ser Ala Glu Lys Pro Gln Pro Ala Lys Pro Ala
1490 1495 1500

Pro Gln Asn Thr Val Leu Pro Lys Pro Thr Tyr Gln Pro Thr Ser
1505 1510 1515

Asp Gln Gln Lys Ala Pro Lys Leu Glu Val Gln Glu Glu Lys Val
1520 1525 1530

Ala Phe His Arg Gln Glu His Glu Asn Thr Glu Met Leu Val Gly
1535 1540 1545

Glu Gln Arg Val Ile Ile Gln Gly Arg Asp Gly Leu Leu Arg His
1550 1555 1560

Val Phe Glu Val Asp Glu Asn Gly Gln Arg Arg Leu Arg Ser Thr
1565 1570 1575

Glu Val Ile Gln Glu Ala Ile Pro Glu Ile Val Glu Ile Gly Thr
1580 1585 1590

Lys Val Lys Thr Val Pro Ala Val Val Ala Thr Gln Glu Lys Pro
1595 1600 1605

Ala Gln Asn Thr Ala Val Lys Ser Glu Glu Ala Ser Lys Gln Leu
1610 1615 1620

Pro Asn Thr Gly Thr Ala Asp Ala Asn Glu Ala Leu Ile Ala Gly
1625 1630 1635

Leu Ala Ser Leu Gly Leu Ala Ser Leu Ala Leu Thr Leu Arg Arg
1640 1645 1650

Lys Arg Glu Asp Lys Asp
1655

<210> 250
<211> 320
<212> PRT
<213> Streptococcus pneumoniae

<400> 250

Met Val Thr Ile Ile Asn Ile Gly Gly Ser Tyr Tyr Leu Gln Gly Ile
1   5   10   15

Leu Asp Glu Tyr Ile Pro Asn Gln Met Lys Ser Thr Leu Gly Ile Ile
            20   25   30

Ser Val Gly Leu Val Ile Thr Tyr Ile Leu Gln Gln Val Met Ser Phe
        35   40   45

Ser Arg Asp Tyr Leu Leu Thr Val Leu Ser Gln Arg Leu Ser Ile Asp
    50   55   60

Val Ile Leu Ser Tyr Ile Arg His Ile Phe Glu Leu Pro Met Ser Phe
65   70   75   80

Phe Ala Thr Arg Arg Thr Gly Glu Ile Ile Ser Arg Phe Thr Asp Ala
                85   90   95

Asn Ser Ile Ile Asp Ala Leu Ala Ser Thr Ile Leu Ser Leu Phe Leu
            100   105   110

Asp Val Ser Ile Leu Ile Leu Val Gly Gly Val Leu Leu Ala Gln Asn
        115   120   125

Pro Asn Leu Phe Leu Leu Ser Leu Ile Ser Ile Pro Ile Tyr Met Phe
    130   135   140

Ile Ile Phe Ser Phe Met Lys Pro Phe Glu Lys Met Asn His Asp Val
145   150   155   160

Met Gln Ser Asn Ser Met Val Ser Ser Ala Ile Ile Glu Asp Ile Asn
                165   170   175

Gly Ile Glu Thr Ile Lys Ser Leu Thr Ser Glu Glu Asn Arg Tyr Gln
            180   185   190

Asn Ile Asp Ser Glu Phe Val Asp Tyr Leu Glu Lys Ser Phe Lys Leu
195 200 205

Ser Lys Tyr Ser Ile Leu Gln Thr Ser Leu Lys Gln Gly Thr Lys Leu
210 215 220

Val Leu Asn Ile Leu Ile Leu Trp Phe Gly Ala Gln Leu Val Met Ser
225 230 235 240

Ser Lys Ile Ser Ile Gly Gln Leu Ile Thr Phe Asn Thr Leu Phe Ser
245 250 255

Tyr Phe Thr Thr Pro Met Glu Asn Ile Ile Asn Leu Gln Thr Lys Leu
260 265 270

Gln Ser Ala Lys Val Ala Asn Asn Arg Leu Asn Glu Val Tyr Leu Val
275 280 285

Glu Ser Glu Phe Gln Val Gln Glu Asn Pro Val His Ser His Phe Leu
290 295 300

Met Gly Asp Ile Glu Phe Asp Asp Leu Ser Tyr Lys Tyr Gly Phe Gly
305 310 315 320

<210> 251
<211> 77
<212> PRT
<213> Streptococcus pneumoniae

<400> 251

Met Tyr Lys His Leu Phe Phe Leu Asp Ser Lys Thr Leu Asp Arg Leu
1 5 10 15

Thr Pro Tyr Ile Leu Val Leu Ala Ser Asp Thr Ile Ala Phe Asn Val
20 25 30

Phe Val Leu Thr Phe Val Ser Ala Val Val Phe Asn Phe Leu Asn Ser
35 40 45

Met Leu Ala Leu Met Ala Ile Phe Ile Gly Ala Gly Tyr Val Val Gly
50 55 60

Phe Trp Leu Leu Ile Leu Asn Glu Asn Gln Arg Ala Asn
65 70 75

<210> 252
<211> 203
<212> PRT
<213> Streptococcus pneumoniae

<400> 252

Met Glu Phe Phe Asp Lys Phe His Ala Leu Cys Phe Gly Phe Leu Val
1 5 10 15

Leu Ile Ile Val Ile Thr Val Pro Tyr Thr Ile Asn His Gly Gly Phe
20 25 30

Phe Gln Asn Glu Ser Ala Leu Ile Leu Val Ser Leu Leu Val Thr Ser
35 40 45

Leu Ser Val Ala Tyr Ala Arg Lys Phe Glu Met Ile Ser Phe Gly Met
50 55 60

Leu Ser Lys Lys Gln Leu Leu Leu Phe Ile Ala Ile Phe Leu Leu Ser
65 70 75 80

Val Leu Glu Thr Leu Val Tyr Ile His Phe Phe Ala Val Ser Ser Gly
85 90 95

Ser Gly Val Gln His Leu Ala Glu Val Ser Arg Gly Ile Ser Leu Ser
100 105 110

Leu Ile Leu Thr Thr Ser Val Phe Gly Pro Ile Gln Glu Glu Leu Ile
115 120 125

Phe Arg Gly Leu Leu Gln Gly Ala Val Phe Asp Asn Ser Trp Leu Gly
130 135 140

Leu Val Leu Thr Ser Ser Leu Phe Ser Phe Met His Gly Pro Ser Asn
145 150 155 160

Val Pro Ser Phe Ile Phe Tyr Leu Leu Gly Gly Leu Leu Leu Gly Phe
165 170 175

```
Ala Tyr Lys Lys Ser Gln Asn Leu Trp Val Ser Thr Leu Val His Met
            180                 185                 190

Leu Tyr Asn Ser Trp Pro Leu Leu Tyr Tyr Leu
        195                 200
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<210> 253
<211> 612
<212> PRT
<213> Streptococcus pneumoniae

<400> 253

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Met Ser Tyr Lys Asp Thr Val Gln Lys Ile Leu Asp Val Ile Gly Gly
1               5                   10                  15

Glu Lys Asn Val Asn Arg Val Thr His Cys Val Thr Arg Leu Arg Leu
            20                  25                  30

Glu Leu Lys Asp Glu Asn Leu Val Asn Asp Asp Asp Val Lys Lys Ile
        35                  40                  45

Pro Gly Val Ile Gly Ile Met Lys Lys Asn Gly Gln Tyr Gln Ile Ile
    50                  55                  60

Leu Gly Asn Asp Val Ala Asn Tyr Tyr Lys Glu Phe Val Lys Leu Gly
65                  70                  75                  80

Asn Phe Glu Ser Asp Ser Val Val Gln Gly His Lys Gly Asn Ile Leu
                85                  90                  95

Glu Arg Ile Ile Glu Tyr Ile Ala Gly Ser Met Thr Pro Ile Ile Pro
            100                 105                 110

Ala Met Leu Gly Gly Gly Met Leu Lys Val Leu Val Ile Ile Leu Pro
        115                 120                 125

Met Leu Gly Ile Leu Gln Ser Asp Ser Gln Thr Ile Ala Phe Leu Thr
    130                 135                 140

Phe Phe Gly Asp Ala Pro Tyr Tyr Phe Leu Pro Leu Leu Leu Ala Tyr
145                 150                 155                 160
```

Ser Ala Ser Gln Lys Leu Lys Val Thr Ser Thr Leu Ala Met Ser Val
165 170 175

Ala Gly Val Leu Leu His Pro Asn Phe Val Gln Met Val Gln Ser Gly
180 185 190

Asn Pro Leu Ser Leu Phe Gly Ala Pro Val Thr Pro Ala Ser Tyr Gly
195 200 205

Ser Ser Val Val Pro Ile Leu Ile Met Val Trp Leu Met Lys Tyr Ile
210 215 220

Glu Lys Ile Ile Ala Lys Leu Thr Leu Ala Ile Thr Lys Ser Phe Leu
225 230 235 240

Gln Pro Thr Leu Val Leu Leu Val Ser Ser Cys Ile Ala Leu Val Val
245 250 255

Val Gly Pro Ile Gly Val Ile Val Gly Glu Gly Leu Ser Asn Leu Val
260 265 270

Gly Gln Met Tyr Gly Val Ala Gly Trp Leu Thr Leu Ala Ile Leu Gly
275 280 285

Ala Ile Met Pro Phe Ile Val Met Thr Gly Met His Trp Ala Phe Ala
290 295 300

Pro Ile Phe Leu Ala Ala Ser Ile Ala Thr Pro Asp Val Leu Ile Leu
305 310 315 320

Pro Ala Met Leu Gly Ser Asn Leu Ala Gln Gly Ala Ala Ser Met Ala
325 330 335

Val Ala Leu Lys Ser Lys Asn Asn Asn Thr Lys Gln Ile Ala Phe Ala
340 345 350

Ala Gly Phe Ser Ala Leu Leu Ala Gly Ile Thr Glu Pro Ala Leu Tyr
355 360 365

Gly Val Thr Leu Lys Tyr Lys Lys Pro Leu Tyr Ala Ala Met Ile Gly

```
    370                 375                 380

Gly Gly Leu Ala Gly Leu Phe Ala Gly Leu Thr Ser Val Lys Ala Tyr
385                 390                 395                 400

Leu Phe Ala Val Pro Ser Leu Ile Ala Leu Pro Gln Phe Ile Tyr Ser
                405                 410                 415

Asp Val Pro Ser Asn Ile Val Asn Ala Leu Ile Val Ala Val Ile Ser
            420                 425                 430

Val Val Ile Thr Phe Val Leu Ala Tyr Ile Phe Gly Ile Asp Glu Glu
        435                 440                 445

Glu Ser Ser Ser Asn Leu Glu Val Glu Ala Gly Val Ser Asn Lys Lys
    450                 455                 460

Met Ile Phe Ser Pro Ile Ser Gly Glu Ile Ile Pro Leu Ser Asp Val
465                 470                 475                 480

Gln Asp Lys Thr Phe Ser Asp Lys Leu Ile Gly Asp Gly Val Ala Ile
                485                 490                 495

Ile Pro Ser Glu Gly Lys Val Tyr Ala Pro Phe Asp Gly Lys Ile Thr
            500                 505                 510

Asn Ile Phe Pro Thr Lys His Ala Ile Gly Leu Lys Ser Asp Glu Gly
        515                 520                 525

Val Glu Leu Leu Ile His Ile Gly Leu Asp Thr Val Glu Leu Lys Gly
    530                 535                 540

Gln Gly Phe Ile Ser His Val Glu Glu Gly Asp Arg Val Phe Lys Asn
545                 550                 555                 560

Gln Leu Ile Phe Glu Met Asp Leu Asn Leu Ile Lys Thr Lys Gly Tyr
                565                 570                 575

Glu Thr Val Thr Pro Val Ile Val Thr Asn Thr Asn Asp Phe Leu Asp
            580                 585                 590
```

Val Leu Val Leu Pro Asn Asn Gln Thr Ile Glu His Ser Lys Glu Leu
        595   600   605

Leu Val Ile Leu
    610

<210> 254
<211> 75
<212> PRT
<213> Streptococcus pneumoniae

<400> 254

Met Val Gly Ile Ala Lys Ser Phe Trp Ile Lys Ser Ala Lys Arg Thr
1   5   10   15

Val Val Ser Leu Ile Leu Asn Leu Leu Leu Leu Ala Val Thr Leu Ile
            20   25   30

Lys Trp Gly Ala Asn Ser Cys Ile Ser Cys Lys Ala Glu Ile Met Leu
        35   40   45

Ser Leu Pro Thr Ala Gly Phe Gly Gly Asn Thr Ser Asn Glu Ser Asp
    50   55   60

Gly Val Trp Arg Asp Ile Cys Asn Asn Leu Phe
65   70   75

<210> 255
<211> 219
<212> PRT
<213> Streptococcus pneumoniae

<400> 255

Met Glu Ser Ile Leu Glu Val Leu Thr Pro Asp Asn Leu Val Phe Ile
1   5   10   15

Phe Lys Gly Phe Gly Leu Thr Leu Tyr Ile Ser Leu Ile Ala Ile Ile
            20   25   30

Leu Ser Thr Ile Ile Gly Thr Val Leu Ala Val Thr Arg Asn Gly Lys
        35   40   45

Asn Pro Val Leu Arg Ile Ile Ser Ser Ile Tyr Ile Glu Phe Val Arg

50 55 60

Asn Val Pro Asn Leu Leu Trp Ile Phe Thr Ile Phe Leu Val Phe Lys
65 70 75 80

Met Lys Ser Thr Pro Ala Gly Ile Thr Ala Phe Thr Leu Phe Thr Ser
85 90 95

Ala Ala Leu Ala Glu Ile Ile Arg Gly Gly Leu Asn Ala Val Asp Lys
100 105 110

Gly Gln Tyr Glu Ala Gly Met Ser Gln Gly Phe Thr Ser Ala Gln Ile
115 120 125

Leu Tyr Tyr Ile Ile Leu Pro Gln Ala Ile Arg Lys Met Leu Pro Ala
130 135 140

Ile Ile Ser Gln Phe Val Thr Val Ile Lys Asp Thr Ser Leu Leu Tyr
145 150 155 160

Ser Val Ile Ala Leu Gln Glu Leu Phe Gly Ala Ser Gln Ile Leu Met
165 170 175

Gly Arg Tyr Phe Glu Pro Glu Gln Val Phe Ser Leu Tyr Ile Leu Ile
180 185 190

Ala Leu Ile Tyr Phe Ser Phe Asn Leu Ala Ile Ser Ser Leu Ser His
195 200 205

Met Leu Ala Lys Arg Trp Gln Gln Ala Ala Glu
210 215

<210> 256
<211> 252
<212> PRT
<213> Streptococcus pneumoniae

<400> 256

Met Ala Leu Val Glu Phe Lys Asn Val Glu Lys Tyr Tyr Gly Asp Tyr
1 5 10 15

His Ala Phe Arg Asn Ile Asn Leu Arg Phe Glu Lys Gly Gln Val Val

20 25 30

Val Leu Leu Gly Pro Ser Gly Ser Gly Lys Ser Thr Leu Ile Arg Thr
35 40 45

Ile Asn Gly Leu Glu Thr Val Asp Lys Gly Ser Leu Leu Val Asn Gly
50 55 60

His Gln Val Ala Gly Ala Ser Gln Lys Asp Leu Val Pro Leu Arg Lys
65 70 75 80

Glu Val Gly Met Val Phe Gln His Phe Asn Leu Tyr Pro His Lys Ala
85 90 95

Val Leu Glu Asn Val Thr Leu Ala Pro Ile Glu Val Leu Gly Ile Asp
100 105 110

Lys Lys Glu Ala Glu Lys Thr Ala Gln Lys Tyr Leu Glu Phe Val Asn
115 120 125

Met Trp Asp Lys Lys Asp Ser Tyr Pro Ala Met Leu Ser Gly Gly Gln
130 135 140

Lys Gln Arg Ile Ala Ile Ala Arg Gly Leu Ala Met His Pro Glu Leu
145 150 155 160

Leu Leu Phe Asp Glu Pro Thr Ser Ala Leu Asp Pro Glu Thr Ile Gly
165 170 175

Asp Val Leu Ala Val Met Gln Lys Leu Ala His Asp Gly Met Asn Met
180 185 190

Ile Ile Val Thr His Glu Met Gly Phe Ala Arg Glu Val Ala Asp Arg
195 200 205

Ile Ile Phe Met Ala Asp Gly Glu Val Leu Val Asp Thr Thr Asp Val
210 215 220

Asp Asn Phe Phe Asp Asn Pro Ser Glu Pro Arg Ala Gln Gln Phe Leu
225 230 235 240

Ser Lys Ile Ile Asn His Glu Ser Asp Lys Val Lys
245 250

<210> 257
<211> 406
<212> PRT
<213> Streptococcus pneumoniae

<400> 257

Met Tyr Arg Tyr Gln Ile Gly Ile Pro Thr Leu Glu Tyr Asp Gln Phe
1 5 10 15

Val Lys Glu His Glu Leu Ala Asn Val Leu Gln Ser Ser Ala Trp Glu
20 25 30

Glu Val Lys Ser Asn Trp Gln His Glu Lys Phe Gly Val Tyr Arg Glu
35 40 45

Glu Lys Leu Leu Ala Thr Ala Ser Ile Leu Ile Arg Thr Leu Pro Leu
50 55 60

Gly Tyr Lys Met Phe Tyr Ile Pro Arg Gly Pro Ile Leu Asp Tyr Gly
65 70 75 80

Asp Lys Glu Leu Leu Asn Phe Ala Ile Gln Ser Ile Lys Ser Tyr Ala
85 90 95

Arg Ser Lys Arg Ala Val Phe Val Thr Phe Asp Pro Ser Ile Cys Leu
100 105 110

Ser Gln Ser Leu Ile Asn Gln Glu Lys Thr Glu Phe Pro Glu Asn Leu
115 120 125

Ala Ile Ile Asp Ser Leu Gln Gln Met Gly Val Arg Trp Ser Gly Lys
130 135 140

Thr Glu Glu Met Gly Asp Thr Ile Gln Pro Arg Ile Gln Ala Lys Ile
145 150 155 160

Tyr Lys Glu Asn Phe Glu Glu Asp Lys Leu Ser Lys Ser Thr Lys Gln
165 170 175

Ala Ile Arg Thr Ala Arg Asn Lys Gly Leu Glu Ile Gln Tyr Gly Gly
180 185 190

Leu Glu Leu Leu Asp Ser Phe Ser Glu Leu Met Lys Lys Thr Glu Lys
195 200 205

Arg Lys Glu Ile His Leu Arg Asn Glu Ala Tyr Tyr Lys Lys Leu Leu
210 215 220

Asp Asn Phe Lys Asp Lys Ala Tyr Ile Thr Leu Ala Thr Leu Asp Val
225 230 235 240

Ser Lys Arg Ser Gln Glu Leu Glu Glu Gln Leu Ala Lys Asn Arg Ala
245 250 255

Leu Glu Glu Thr Phe Thr Glu Ser Thr Arg Thr Ser Lys Val Glu Ala
260 265 270

Gln Lys Lys Glu Lys Glu Arg Leu Leu Glu Glu Leu Thr Phe Leu Gln
275 280 285

Glu Tyr Ile Asp Val Gly Gln Ala Arg Val Pro Leu Ala Ala Thr Leu
290 295 300

Ser Leu Glu Phe Gly Thr Thr Ser Val Asn Ile Tyr Ala Gly Met Asp
305 310 315 320

Asp Asp Phe Lys Arg Tyr Asn Ala Pro Ile Leu Thr Trp Tyr Glu Thr
325 330 335

Ala Arg Tyr Ala Phe Glu Arg Gly Met Ile Trp Gln Asn Leu Gly Gly
340 345 350

Val Glu Asn Ser Leu Asn Gly Gly Leu Tyr His Phe Lys Glu Lys Phe
355 360 365

Asn Pro Thr Ile Glu Glu Tyr Leu Gly Glu Phe Thr Met Pro Thr His
370 375 380

Pro Leu Tyr Pro Leu Leu Arg Leu Ala Leu Asp Phe Arg Lys Thr Leu
385 390 395 400

Arg Lys Lys His Arg Lys
405

<210> 258
<211> 194
<212> PRT
<213> Streptococcus pneumoniae

<400> 258

Met Lys Glu Ile Phe Met Ala Lys Lys Gly Thr Leu Thr Gly Leu Leu
1 5 10 15

Leu Phe Gly Ile Phe Phe Gly Ala Gly Asn Leu Ile Phe Pro Pro Ser
20 25 30

Leu Gly Ala Leu Ser Gly Glu His Phe Leu Pro Ala Ile Ala Gly Phe
35 40 45

Val Phe Ser Gly Val Gly Ile Ala Val Leu Thr Leu Ile Ile Gly Thr
50 55 60

Leu Asn Pro Lys Gly Tyr Ile Tyr Glu Ile Ser Thr Lys Ile Ala Pro
65 70 75 80

Trp Phe Ala Thr Leu Tyr Leu Ser Val Leu Tyr Leu Ser Ile Gly Pro
85 90 95

Phe Phe Ala Thr Pro Arg Thr Ala Thr Thr Ala Tyr Glu Val Gly Ile
100 105 110

Ser Pro Leu Leu Ser Asp Ala Asn Lys Gly Leu Gly Leu Ile Val Phe
115 120 125

Thr Val Leu Tyr Phe Ala Ala Ala Tyr Leu Ile Ser Leu Asn Pro Ser
130 135 140

Lys Ile Leu Asp Arg Ile Gly Arg Ile Leu Thr Pro Val Phe Ala Ile
145 150 155 160

Leu Ile Val Ile Leu Val Val Leu Gly Ala Ile Lys Tyr Gly Gly Thr
165 170 175

Ser Pro Gln Ala Ala Ser Leu Leu Ile Lys Leu Leu Pro Leu Val Gln
180 185 190

Val Ser

<210> 259
<211> 561
<212> PRT
<213> Streptococcus pneumoniae

<400> 259

Met Lys Gly Gly Thr Pro Gly Val Tyr Ile Leu Ser Gln Ala Thr Gln
1 5 10 15

Glu Ile Phe Gly Ser Thr Ala Gln Leu Phe Leu Ala Ala Met Val Thr
20 25 30

Val Thr Cys Phe Thr Thr Thr Val Gly Leu Ile Val Ser Thr Ala Glu
35 40 45

Phe Phe Asn Glu Arg Phe Pro Gln Ile Ser Tyr Lys Val Tyr Ala Thr
50 55 60

Ala Phe Thr Leu Ile Gly Phe Ala Ile Ala Asn Leu Gly Leu Asp Ala
65 70 75 80

Ile Ile Lys Tyr Ser Ile Pro Val Leu Val Ile Leu Tyr Pro Ile Thr
85 90 95

Ile Ala Ile Val Met Ile Val Ile Val Asn Lys Phe Val Ala Leu Ser
100 105 110

Lys Pro Gly Met Gln Leu Thr Ile Ala Val Val Thr Val Ile Ala Ile
115 120 125

Ala Ser Val Leu Gly Ser Ser Leu Arg Leu Ser Phe Leu Gln Ile Leu
130 135 140

Leu Ala Phe Phe Leu Leu Pro Arg His Leu Ser His Gly Trp Cys Gln
145 150 155 160

Pro Leu Leu Glu Ser Cys Ser His Trp Phe Tyr Gln Thr Ser Lys Lys
165 170 175

Ala Met Phe Leu Lys Trp Asn Asn His Leu Asn His Phe Cys Ser Gln
180 185 190

Val Tyr Arg Ser Asp Phe Leu Phe Leu Ser Asp Asp Lys Cys Val Ile
195 200 205

Ile Gly Ser Glu Arg Gly Glu Glu Met Asn Gln Thr Val Glu Tyr Ile
210 215 220

Lys Glu Leu Thr Ala Ile Ala Ser Pro Thr Gly Phe Thr Arg Glu Ile
225 230 235 240

Ala Asp Tyr Leu Val Lys Thr Leu Glu Gly Phe Gly Tyr Gln Pro Val
245 250 255

Arg Thr Ser Lys Gly Gly Val Asn Val Thr Ile Lys Gly Gln Asn Asp
260 265 270

Glu Gln His Arg Tyr Val Thr Ala His Val Asp Thr Leu Gly Ala Ile
275 280 285

Val Arg Ala Val Lys Pro Asp Gly Arg Leu Lys Met Asp Arg Ile Gly
290 295 300

Gly Phe Pro Trp Asn Met Ile Glu Gly Glu Asn Cys Thr Ile His Val
305 310 315 320

Ala Ser Thr Gly Glu Lys Val Ser Gly Thr Ile Leu Ile His Gln Thr
325 330 335

Ser Cys His Val Tyr Lys Asp Ala Gly Thr Ala Glu Arg Thr Gln Asp
340 345 350

Asn Met Glu Val Arg Leu Asp Ala Lys Val Thr Ser Glu Lys Glu Thr
355 360 365

Arg Ala Leu Gly Ile Glu Val Gly Asp Phe Ile Ser Phe Asp Pro Arg
370 375 380

Thr Val Val Thr Glu Thr Gly Phe Ile Lys Ser Arg His Leu Asp Asp
385 390 395 400

Lys Val Ser Ala Ala Ile Leu Leu Asn Leu Leu Arg Ile Tyr Lys Glu
405 410 415

Glu Lys Ile Glu Leu Pro Val Thr Thr His Phe Ala Phe Ser Val Phe
420 425 430

Glu Glu Val Gly His Gly Ala Asn Ser Asn Ile Pro Ala Gln Val Val
435 440 445

Glu Tyr Leu Ala Val Asp Met Gly Ala Met Gly Asp Asp Gln Gln Thr
450 455 460

Asp Glu Tyr Thr Val Ser Ile Cys Val Lys Asp Ala Ser Gly Pro Tyr
465 470 475 480

His Tyr Asp Phe Arg Gln His Leu Val Ala Leu Ala Lys Glu Gln Asp
485 490 495

Ile Pro Phe Lys Leu Asp Ile Tyr Pro Phe Tyr Gly Ser Asp Ala Ser
500 505 510

Ala Ala Met Ser Ala Gly Ala Glu Val Lys His Ala Leu Leu Gly Ala
515 520 525

Gly Ile Glu Ser Ser His Ser Tyr Glu Arg Thr His Ile Asp Ser Val
530 535 540

Ile Ala Thr Glu Arg Met Val Asp Ala Tyr Leu Lys Ser Thr Leu Val
545 550 555 560

Asp

<210> 260
<211> 330
<212> PRT
<213> Streptococcus pneumoniae

<400> 260

Met Ala Met Ile Glu Val Glu His Leu Gln Lys Asn Phe Val Lys Thr
1 5 10 15

Val Lys Glu Pro Gly Leu Lys Gly Ala Leu Arg Ser Phe Ile His Pro
20 25 30

Glu Lys Gln Thr Phe Glu Ala Val Lys Asp Leu Thr Phe Glu Val Pro
35 40 45

Lys Gly Gln Ile Leu Gly Phe Ile Gly Ala Asn Gly Ala Gly Lys Ser
50 55 60

Thr Thr Ile Lys Met Leu Thr Gly Ile Leu Lys Pro Thr Ser Gly Phe
65 70 75 80

Cys Arg Ile Asn Gly Lys Ile Pro Gln Asp Asn Arg Gln Asp Tyr Val
85 90 95

Lys Asp Ile Gly Val Val Phe Gly Gln Arg Thr Gln Leu Trp Trp Asp
100 105 110

Leu Ala Leu Gln Glu Thr Tyr Thr Val Leu Lys Glu Ile Tyr Asp Val
115 120 125

Pro Asp Ser Leu Phe His Lys Arg Met Asp Phe Leu Asn Glu Val Leu
130 135 140

Asp Leu Lys Asp Phe Ile Lys Asp Pro Val Arg Thr Leu Ser Leu Gly
145 150 155 160

Gln Arg Met Arg Ala Asp Ile Ala Ala Ser Leu Leu His Asn Pro Lys
165 170 175

Val Leu Phe Leu Asp Glu Pro Thr Ile Gly Leu Asp Val Ser Val Lys
180 185 190

Asp Asn Ile Arg Arg Ala Ile Thr Gln Ile Asn Gln Glu Glu Glu Thr
195 200 205

Thr Ile Leu Leu Thr Thr His Asp Leu Ser Asp Ile Glu Gln Leu Cys

210 215 220

Asp Arg Ile Phe Met Ile Asp Lys Gly Gln Glu Ile Phe Asp Gly Thr
225 230 235 240

Val Ser Gln Leu Lys Glu Thr Phe Gly Lys Met Lys Thr Leu Ser Phe
245 250 255

Glu Leu Leu Pro Gly Gln Ser His Leu Val Ser His Tyr Asp Gly Leu
260 265 270

Ser Asp Met Thr Ile Asp Arg Gln Gly Asn Ser Leu Asn Ile Glu Phe
275 280 285

Asp Ser Ser Arg Tyr Gln Ser Ala Asp Ile Ile Lys Gln Thr Leu Ser
290 295 300

Asp Phe Glu Ile Arg Asp Leu Lys Met Val Asp Thr Asp Ile Glu Asp
305 310 315 320

Ile Ile Arg Arg Phe Tyr Arg Lys Glu Leu
325 330

<210> 261
<211> 491
<212> PRT
<213> Streptococcus pneumoniae

<400> 261

Met Asp Ala Ile Phe Asp Leu Ile Gly Lys Val Phe Asn Pro Ile Leu
1 5 10 15

Glu Met Gly Gly Pro Val Ile Met Leu Ile Ile Leu Thr Val Leu Ala
20 25 30

Leu Leu Phe Gly Val Lys Phe Ser Lys Ala Leu Glu Gly Gly Ile Lys
35 40 45

Leu Ala Ile Ala Leu Thr Gly Ile Gly Ala Ile Ile Gly Met Leu Asn
50 55 60

Thr Ala Phe Ser Ala Ser Leu Ala Lys Phe Val Glu Asn Thr Gly Ile

65 70 75 80

Gln Leu Ser Ile Thr Asp Val Gly Trp Ala Pro Leu Ala Thr Ile Thr
85 90 95

Trp Gly Ser Ala Trp Thr Leu Tyr Phe Leu Leu Ile Met Leu Ile Val
100 105 110

Asn Ile Val Met Leu Ala Met Lys Lys Thr Asp Thr Leu Asp Val Asp
115 120 125

Ile Phe Asp Ile Trp His Leu Ser Ile Thr Gly Leu Leu Ile Lys Trp
130 135 140

Tyr Ala Asp Asn Asn Gly Val Ser Gln Gly Val Ser Leu Phe Ile Ala
145 150 155 160

Thr Ala Ala Ile Val Leu Val Gly Val Leu Lys Ile Ile Asn Ser Asp
165 170 175

Leu Met Lys Pro Thr Phe Asp Asp Leu Leu Asn Ala Pro Ser Ser Ser
180 185 190

Pro Met Thr Ser Thr His Met Asn Tyr Met Met Asn Pro Val Ile Met
195 200 205

Val Leu Asp Lys Ile Phe Glu Lys Phe Phe Pro Gly Leu Asp Lys Tyr
210 215 220

Asp Phe Asp Ala Ala Lys Leu Asn Lys Lys Ile Gly Phe Trp Gly Ser
225 230 235 240

Lys Phe Phe Ile Gly Phe Ile Leu Gly Ile Val Ile Gly Ile Met Gly
245 250 255

Thr Pro His Pro Ile Ala Gly Val Ala Asp Ala Asp Lys Trp Arg Leu
260 265 270

Val Ile Lys Gly Trp Leu Ser Leu Gly Leu Thr Ala Gly Val Ser Leu
275 280 285

Glu Leu Phe Ser Leu Ile Gly Ser Trp Phe Ile Ala Ala Val Glu Pro
290 295 300

Leu Ser Gln Gly Ile Thr Asn Val Ala Thr Lys Arg Leu Gln Gly Arg
305 310 315 320

Lys Phe Asn Ile Gly Leu Asp Trp Pro Phe Ile Ala Gly Arg Ala Glu
325 330 335

Ile Trp Ala Cys Ala Asn Val Leu Ala Pro Ile Met Leu Ile Glu Ala
340 345 350

Val Leu Leu Ser Lys Val Gly Asn Gly Ile Leu Pro Leu Ala Gly Ile
355 360 365

Ile Ala Met Gly Val Thr Pro Ala Leu Leu Val Val Thr Arg Gly Lys
370 375 380

Leu Leu Arg Met Ile Ile Phe Gly Thr Leu Leu Leu Pro Leu Phe Leu
385 390 395 400

Leu Ser Gly Thr Leu Ile Ala Pro Phe Ala Thr Glu Leu Ala Lys Gly
405 410 415

Val Gly Ala Phe Pro Glu Gly Val Ser Gln Thr Gln Leu Ile Thr His
420 425 430

Ser Thr Leu Glu Gly Pro Ile Glu Lys Leu Leu Gly Trp Thr Ile Gly
435 440 445

Asn Thr Thr Thr Gly Asp Ile Lys Ala Ile Leu Gly Ala Val Val Phe
450 455 460

Leu Val Phe Tyr Ile Gly Ile Phe Ala Trp Tyr Arg Lys Gln Met Ile
465 470 475 480

Lys Arg Asn Glu Glu Tyr Ala Ala Lys Ala Lys
485 490

<210> 262
<211> 106
<212> PRT

<213> Streptococcus pneumoniae

<400> 262

Met Ile Leu Thr Leu Val Val Cys Ile Ile Leu Thr Lys Leu Phe Arg
1 5 10 15

Leu Lys Lys Leu Gly Arg Asn Phe Ala Asp Leu Ala Phe Pro Val Leu
20 25 30

Val Phe Glu Tyr Tyr Leu Ile Thr Ala Lys Thr Phe Thr His Asn Phe
35 40 45

Leu Pro Arg Leu Gly Leu Ala Leu Ser Ile Leu Ala Ile Ile Leu Val
50 55 60

Phe Phe Phe Leu Leu Lys Lys Arg Ser Phe Tyr Tyr Pro Lys Phe Ile
65 70 75 80

Lys Phe Phe Trp Arg Ala Gly Phe Leu Leu Thr Leu Ile Met Tyr Ile
85 90 95

Glu Met Ile Val Glu Leu Phe Leu Met Lys
100 105

<210> 263
<211> 236
<212> PRT
<213> Streptococcus pneumoniae

<400> 263

Met Gly His Ile Phe Phe Phe Leu Ser Val Phe Leu Ala Gly Ile Leu
1 5 10 15

Ser Phe Phe Ser Pro Cys Ile Leu Pro Leu Leu Pro Val Tyr Thr Gly
20 25 30

Val Leu Leu Asp Asp Lys Asp Gly Ala Gln Ala Ser Ser Gly Lys Phe
35 40 45

Ser Ile Ser Val Thr Ser Leu Leu Arg Thr Leu Ala Phe Ile Ala Gly
50 55 60

Ile Ser Phe Ile Phe Ile Leu Leu Gly Tyr Gly Ala Gly Phe Leu Gly
65 70 75 80

Asp Leu Leu Tyr Ala Ser Trp Phe Gln Tyr Leu Thr Gly Ala Ile Ile
85 90 95

Ile Leu Leu Gly Leu His Gln Met Glu Ile Leu His Phe Lys Gly Leu
100 105 110

Tyr Lys Glu Lys Arg Leu Gln Leu Gln Gly Gln Gly Gln Asn Gly Lys
115 120 125

Gly Tyr Ser Gln Ala Phe Leu Leu Gly Leu Thr Phe Ser Phe Ala Trp
130 135 140

Thr Pro Cys Val Gly Pro Val Leu Gly Ser Val Leu Ala Leu Ala Ala
145 150 155 160

Ser Gly Gly Ser Gly Ala Trp Gln Gly Ala Gly Leu Met Leu Val Tyr
165 170 175

Thr Leu Gly Leu Ala Leu Pro Phe Leu Leu Leu Ala Leu Thr Ser Ser
180 185 190

Tyr Val Leu Lys His Phe Arg Lys Leu His Pro Tyr Leu Gly Ile Leu
195 200 205

Lys Lys Val Gly Gly Phe Leu Ile Ile Val Met Gly Phe Leu Val Leu
210 215 220

Phe Gly Asn Ala Ser Ile Leu Ser Gln Leu Phe Glu
225 230 235

<210> 264
<211> 91
<212> PRT
<213> Streptococcus pneumoniae

<400> 264

Met Gly Met Thr Asn Leu Ser Gln Asn Arg Ala Asn Arg Asn Leu Asn
1 5 10 15

Met Leu Asp Met His Ala Asn Cys Ser Val Ser Asp Ile Gln Ser Ser
20 25 30

Met Ser Leu Asp Lys Phe Asn Leu Asn Trp Ile Leu His Lys Leu Lys
35 40 45

Gly Cys Gln Leu Pro Arg Thr Ser Cys Met Lys Ser Arg Met Asp Thr
50 55 60

Asp Asn Phe Gln Thr Lys Leu Leu Cys His Leu Thr Phe Asn Asn Glu
65 70 75 80

Ser Pro Ile Asp Met Leu Thr Thr Leu Asn Cys
85 90

<210> 265
<211> 332
<212> PRT
<213> Streptococcus pneumoniae

<400> 265

Met Asn Lys Arg Leu Phe Ser Lys Met Ser Leu Val Thr Leu Pro Ile
1 5 10 15

Leu Ala Leu Phe Ser Gln Ser Val Leu Ala Glu Glu Asn Ile His Phe
20 25 30

Ser Ser Cys Lys Glu Ala Trp Ala Asn Gly Tyr Ser Asp Ile His Glu
35 40 45

Gly Glu Pro Gly Tyr Ser Ala Lys Leu Asp Arg Asp His Asp Gly Val
50 55 60

Ala Cys Glu Leu Lys Asn Ala Pro Lys Gly Ala Phe Lys Ala Lys Gln
65 70 75 80

Ser Thr Ala Ile Gln Ile Asn Thr Ser Ser Ala Thr Thr Ser Gly Trp
85 90 95

Val Lys Gln Asp Gly Ala Trp Tyr Tyr Phe Asp Gly Asn Gly Asn Leu
100 105 110

Val Lys Asn Ala Trp Gln Gly Ser Tyr Tyr Leu Lys Ala Asp Gly Lys
115 120 125

Met Ala Gln Ser Glu Trp Ile Tyr Asp Ser Ser Tyr Gln Ala Trp Tyr
130 135 140

Tyr Leu Lys Ser Asp Gly Ser Tyr Ala Lys Asn Ala Trp Gln Gly Ala
145 150 155 160

Tyr Tyr Leu Lys Ser Asn Gly Lys Met Ala Gln Gly Glu Trp Val Tyr
165 170 175

Asp Ser Ser Tyr Gln Ala Trp Tyr Tyr Leu Lys Ser Asp Gly Ser Tyr
180 185 190

Ala Arg Asn Ala Trp Gln Gly Asn Tyr Tyr Leu Lys Ser Asp Gly Lys
195 200 205

Met Ala Lys Gly Glu Trp Val Tyr Asp Ala Thr Tyr Gln Ala Trp Tyr
210 215 220

Tyr Leu Thr Ser Asp Gly Ser Tyr Ala Tyr Ser Thr Trp Gln Gly Asn
225 230 235 240

Tyr Tyr Leu Lys Ser Asp Gly Lys Met Ala Val Asn Glu Trp Val Asp
245 250 255

Gly Gly Arg Tyr Tyr Val Gly Ala Asp Gly Val Trp Lys Glu Val Gln
260 265 270

Ala Ser Thr Ala Ser Ser Ser Asn Asp Ser Asn Ser Glu Tyr Ser Ala
275 280 285

Ala Leu Gly Lys Ala Lys Ser Tyr Asn Ser Leu Phe His Met Ser Lys
290 295 300

Lys Arg Met Tyr Arg Gln Leu Thr Ser Asp Phe Asp Lys Phe Ser Asn
305 310 315 320

Asp Ala Ala Gln Tyr Ala Ile Asp His Leu Asp Asp
325 330

<210> 266
<211> 412
<212> PRT
<213> Streptococcus pneumoniae

<400> 266

```
Met Ile Glu Thr Glu Lys Lys Glu Glu Arg Val Leu Leu Ile Gly Val
1               5                   10                  15

Glu Leu Gln Gly Met Asp Ser Phe Asp Leu Ser Met Glu Glu Leu Ala
            20                  25                  30

Ser Leu Ala Lys Thr Ala Gly Ala Val Val Val Asp Ser Tyr Arg Gln
        35                  40                  45

Lys Arg Glu Lys Tyr Asp Ser Lys Thr Phe Val Gly Ser Gly Lys Leu
    50                  55                  60

Glu Glu Ile Ala Leu Met Val Asp Ala Glu Glu Ile Thr Thr Val Ile
65                  70                  75                  80

Val Asn Asn Arg Leu Thr Pro Arg Gln Asn Val Asn Leu Glu Glu Val
                85                  90                  95

Leu Gly Val Lys Val Ile Asp Arg Met Gln Leu Ile Leu Asp Ile Phe
            100                 105                 110

Ala Met Arg Ala Arg Ser His Glu Gly Lys Leu Gln Val His Leu Ala
        115                 120                 125

Gln Leu Lys Tyr Leu Leu Pro Arg Leu Val Gly Gln Gly Ile Met Leu
    130                 135                 140

Ser Arg Gln Ala Gly Gly Ile Gly Ser Arg Gly Pro Gly Glu Ser Gln
145                 150                 155                 160

Leu Glu Leu Asn Arg Arg Ser Val Arg Asn Gln Ile Thr Asp Ile Glu
                165                 170                 175

Arg Gln Leu Lys Val Val Glu Lys Asn Arg Ala Thr Val Arg Glu Lys
            180                 185                 190
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Arg Leu Glu Ser Ser Thr Phe Lys Ile Gly Leu Ile Gly Tyr Thr Asn
        195                 200                 205

Ala Gly Lys Ser Thr Ile Met Asn Ile Leu Thr Ser Lys Thr Gln Tyr
    210                 215                 220

Glu Ala Asp Glu Leu Phe Ala Thr Leu Asp Ala Thr Thr Lys Ser Ile
225                 230                 235                 240

His Leu Gly Gly Asn Leu Gln Val Thr Leu Thr Asp Thr Val Gly Phe
                245                 250                 255

Ile Gln Asp Leu Pro Thr Glu Leu Val Ser Ser Phe Lys Ser Thr Leu
            260                 265                 270

Glu Glu Ser Lys His Val Asp Leu Leu Val His Val Ile Asp Ala Ser
        275                 280                 285

Asn Pro Tyr His Glu Glu His Glu Lys Thr Val Leu Ser Ile Met Lys
    290                 295                 300

Asp Leu Asp Met Glu Asp Ile Pro His Leu Thr Leu Tyr Asn Lys Ala
305                 310                 315                 320

Asp Leu Val Glu Asp Phe Thr Pro Thr Gln Thr Pro Tyr Thr Leu Ile
                325                 330                 335

Ser Ala Lys Ser Glu Asp Ser Arg Glu Asn Leu Gln Ala Leu Leu Leu
            340                 345                 350

Asp Lys Ile Lys Glu Ile Phe Glu Ala Phe Thr Leu Arg Val Pro Phe
        355                 360                 365

Ser Lys Ser Tyr Lys Ile His Asp Leu Glu Ser Val Ala Ile Leu Glu
    370                 375                 380

Glu Arg Asp Tyr Gln Glu Asp Gly Glu Val Ile Thr Gly Tyr Ile Ser
385                 390                 395                 400

Glu Lys Asn Lys Trp Arg Leu Glu Glu Phe Tyr Asp
                405                 410
```

<210> 267
<211> 84
<212> PRT
<213> Streptococcus pneumoniae

<400> 267

Met Val Tyr Leu Val Leu Gly Ile Leu Leu Leu Leu Leu Tyr Val Phe
1 5 10 15

Ala Thr Pro Glu Ser Ile Lys Gly Thr Val Asn Ile Val Ala Met Val
20 25 30

Cys Ile Leu Val Ala Leu Leu Ile Leu Leu Val Leu Ser Phe Leu Lys
35 40 45

Ile Phe Gln Leu Pro Thr Glu Ile Phe Leu Ala Ile Ala Met Leu Ile
50 55 60

Leu Ala Tyr Phe Ser Val Arg Asp Ile Thr Leu Met Pro Val Lys Lys
65 70 75 80

Ser Lys Arg Arg

<210> 268
<211> 211
<212> PRT
<213> Streptococcus pneumoniae

<400> 268

Met Tyr Gly Val Arg Lys Leu Ile Val Ala Asp Tyr Asp Ile Ile Glu
1 5 10 15

Pro Ser Asn Leu Asn Arg Gln Ile Leu Tyr Thr Glu Ser Asp Val Gly
20 25 30

Lys Glu Lys Ile Asn Val Leu Ser Glu Lys Ile His Lys Tyr Asn Ser
35 40 45

Asp Val Gln Val Val Pro Ile Ser Ile Lys Val Ser Ser Val Glu Glu
50 55 60

Leu Glu Lys Ile Val Ala Glu Tyr Gly Ser Ile Asp Phe Ile Val Lys
65 70 75 80

Ala Ile Asp Thr Pro Ile Asp Ile Ile Lys Ile Val Asn Gln Phe Ala
85 90 95

Val Ser His Lys Ile Ser Tyr Ile Ser Gly Gly Phe Asn Gly Cys Tyr
100 105 110

Leu Ile Ile Asp Asn Ile Tyr Ile Pro Thr Ile Gly Ser Cys Phe Gly
115 120 125

Cys Arg Asn Ile Asn Lys Asp Ile Asn Lys Tyr Thr Leu Ser Asp Lys
130 135 140

Thr Lys Trp Pro Thr Thr Pro Glu Met Pro Ala Ile Leu Gly Gly Ile
145 150 155 160

Met Thr Asn Leu Ile Ile Lys Ile Phe Leu Gly Cys Tyr Asn Glu Ile
165 170 175

Leu Ile Asp Asn Ala Tyr Val Tyr Asn Met Arg Asn His Ala Leu Ser
180 185 190

Gln Glu Lys Tyr Val Leu Glu Asn Gly Glu Cys Pro Ile Cys Lys Lys
195 200 205

Ile Ile Lys
210

<210> 269
<211> 126
<212> PRT
<213> Streptococcus pneumoniae

<400> 269

Met Lys Asp Asn Asn Ile Arg Ala Lys Thr Phe Ile Arg Ser Val Cys
1 5 10 15

Phe Cys Leu Leu Ser Gly Gly Val Ala Phe Leu Ser Ala Ile Gly Gln
20 25 30

Phe Thr Val Ile Glu Thr Gln Leu Ile Val Leu Phe Leu Gly Ile Ile
35 40 45

Phe Ala Ile Tyr Tyr Ala Tyr Tyr Asn Lys Asn Ile Gln Thr Ser Leu
50 55 60

Glu Asn Ile Val Trp Leu Phe Ser Ser Phe Glu Ile Leu Phe Leu Leu
65 70 75 80

Val Asn Phe Arg Thr Phe Ile Gln Leu Pro Val Asp Ile Phe Ile Gly
85 90 95

Met Ile Ile Phe Leu Met Leu Trp Ile Phe Ile Met Leu Gly Ile Val
100 105 110

Cys Leu Ser Tyr Tyr Ile Thr Leu Leu Phe Ser Lys Glu Ala
115 120 125

<210> 270
<211> 217
<212> PRT
<213> Streptococcus pneumoniae

<400> 270

Met Gly Gln Lys Ser Gln Asn Leu Thr Ser Gly Glu Leu Lys Arg Ile
1 5 10 15

Gly Leu Val Ser Asp Thr Ser Gly Phe Tyr Glu Lys Met Ser Leu Tyr
20 25 30

Asn Asn Leu Leu Phe Tyr Ser Lys Phe Tyr Asn Ile Ser Lys Ser Arg
35 40 45

Val Asp Asn Leu Leu Lys Arg Val Gly Leu Tyr Asp Ser Arg Lys Met
50 55 60

Val Ala Gly Lys Leu Ser Thr Gly Met Arg Gln Arg Met Leu Leu Ala
65 70 75 80

Arg Ala Leu Ile Asn Asn Pro Ala Val Leu Phe Leu Asp Glu Pro Thr
85 90 95

Ser Gly Leu Asp Pro Thr Thr Ser Arg Thr Ile His Glu Leu Ile Leu
100 105 110

Glu Leu Lys Thr Ala Gly Thr Thr Ile Phe Leu Thr Thr His Asp Met
115 120 125

Asn Glu Ala Thr Leu Leu Cys Asp Tyr Val Ala Leu Leu Asn Lys Gly
130 135 140

Lys Leu Val Glu Gln Gly Ala Pro Ser Glu Leu Ile Gln Arg Tyr Asn
145 150 155 160

Lys Asp Lys Lys Ile Lys Val Thr Asp Tyr Asn Gly Asn Gln Ile Thr
165 170 175

Phe Asp Phe Thr Ser Leu Glu Gln Val Ser Gln Thr Asp Leu Glu Asn
180 185 190

Ile Phe Ser Ile His Ser Cys Glu Pro Thr Leu Glu Asp Ile Phe Ile
195 200 205

Thr Leu Thr Gly Gly Lys Leu Asn Ala
210 215

<210> 271
<211> 254
<212> PRT
<213> Streptococcus pneumoniae

<400> 271

Met Glu Phe Phe Ile Cys Asn Leu Val Arg Val Val Gln Ser Pro Arg
1 5 10 15

Phe Tyr Met Ser Leu Phe Leu Thr Leu Leu Cys Met Ser Leu Gly Asn
20 25 30

Phe Leu Ala Phe Asn Gly Ile Tyr Lys Ile Glu Gly Leu Ser Ile Phe
35 40 45

Phe Ala Ala Ser Ser Ile Arg Gly Phe Ser Pro Ile Ser Leu Val Ala
50 55 60

Ala Leu Ile Cys Thr Leu Pro Tyr Ser Ser Gln Ile Ile Glu Asp Ala
65 70 75 80

Glu Ser His Phe Leu Thr Ala Gln Leu Cys Arg Ile Ser Lys Lys Lys
85 90 95

Tyr Leu Ala Ile Val Gly Ser Thr Val Ile Ile Ser Ser Phe Leu Val
100 105 110

Phe Phe Leu Pro Tyr Leu Leu Leu Leu Gly Ile Asn Leu Leu Val Thr
115 120 125

Pro Tyr Gln Glu Ile Tyr Ile Gly Asp Tyr Ser Gly Ala Leu Lys Glu
130 135 140

Leu Phe Asp Ser Asn Gln Phe Leu Tyr Ser Leu Val Thr Thr Leu Trp
145 150 155 160

Tyr Gly Val Trp Gly Ala Val Phe Ser Ile Phe Gly Leu Ala Ser Ala
165 170 175

Leu Leu Val Lys Lys Lys Ile Gly Ala Ile Phe Ile Pro Val Ala Tyr
180 185 190

Met Met Val Gly Gly Ile Phe Trp Ala Ile Leu Gly Leu Ser Tyr Leu
195 200 205

Glu Pro Val Thr Thr Leu Ala Leu Gly Tyr Gln Lys Asp Ile Ser Leu
210 215 220

Ser Leu Val Ser Ala His Leu Ala Phe Ile Leu Phe Val Ser Cys Leu
225 230 235 240

Val Val Tyr Gly Thr Phe Phe Leu His Ser Glu Asp Tyr Val
245 250

<210> 272
<211> 215
<212> PRT
<213> Streptococcus pneumoniae

<400> 272

```
Met Asn Glu Ile Ile Thr Leu Lys Asn Ile Glu Leu Lys Leu Lys Lys
1               5                   10                  15

Thr Cys Val Phe Gln Asn Leu Asn Phe Ser Cys Lys Gln Gly Glu Ile
            20                  25                  30

Ile Gly Ile Thr Gly Ala Asn Gly Ser Gly Lys Ser Val Leu Phe Lys
        35                  40                  45

Leu Ile Ala Gly Leu Tyr Ser Pro Ser Tyr Gly Glu Val Leu Ile Asn
    50                  55                  60

Gly Glu Asn Ile Val Pro Glu Arg Lys Ile Pro Ala Asn Leu Gly Ala
65                  70                  75                  80

Leu Ile Glu Glu Pro Gly Phe Ile Asn Tyr Tyr Ser Gly Phe Lys Asn
                85                  90                  95

Leu Gln Tyr Leu Ala Ser Ile Arg Gly Val Val Gly Asn Gln Glu Ile
            100                 105                 110

Asn Asp Thr Leu Lys Ile Val Gly Leu Tyr Glu Gln Lys Asp Gln Lys
        115                 120                 125

Val Lys Thr Tyr Ser Leu Gly Met Arg Lys Lys Leu Gly Ile Ala Gln
    130                 135                 140

Ala Ile Met Glu Asn Pro Ser Ile Leu Leu Leu Asp Glu Pro Met Asn
145                 150                 155                 160

Ala Leu Asp Lys Ser Ser Val Glu Asn Met Arg Thr Leu Phe Arg Lys
                165                 170                 175

Leu Ser Ser Glu Lys Gly Thr Thr Ile Leu Ile Ala Ser His Ser Glu
            180                 185                 190

Glu Asp Ile Arg Ile Leu Cys Asp Lys Val Tyr Ala Ile Glu Asp Lys
        195                 200                 205

Val Cys Thr Leu Cys Ser Asp
    210                 215
```

<210> 273
<211> 252
<212> PRT
<213> Streptococcus pneumoniae

<400> 273

Met Ser Glu Thr Ile Leu Glu Ile Lys Glu Leu Lys Lys Ser Phe Gly
1 5 10 15

Asp Asn Pro Ile Leu Gln Gly Leu Ser Leu Glu Ile Lys Lys Gly Glu
20 25 30

Val Val Val Ile Leu Gly Pro Ser Gly Cys Gly Lys Ser Thr Leu Leu
35 40 45

Arg Cys Leu Asn Gly Leu Glu Ser Ile Gln Gly Gly Asp Ile Leu Leu
50 55 60

Asp Gly Gln Ser Ile Val Glu Asn Lys Lys Asp Phe His Leu Val Arg
65 70 75 80

Gln Lys Ile Gly Met Val Phe Gln Ser Tyr Glu Leu Phe Pro His Leu
85 90 95

Asp Val Leu Gln Asn Leu Ile Leu Gly Pro Ile Lys Ala Gln Gly Arg
100 105 110

Asp Lys Lys Glu Val Thr Glu Glu Ala Leu Gln Leu Leu Glu Arg Val
115 120 125

Gly Leu Leu Asp Lys Gln His Ser Phe Ala Arg Gln Leu Ser Gly Gly
130 135 140

Gln Lys Gln Arg Val Ala Ile Val Arg Ala Leu Leu Met His Pro Glu
145 150 155 160

Ile Ile Leu Phe Asp Glu Val Thr Ala Ser Leu Asp Pro Glu Met Val
165 170 175

Arg Glu Val Leu Glu Leu Ile Asn Asp Leu Ala Gln Glu Gly Arg Thr
180 185 190

Met Ile Leu Val Thr His Glu Met Gln Phe Ala Gln Ala Ile Thr Asp
195 200 205

Arg Ile Ile Phe Leu Asp Gln Gly Lys Ile Ala Glu Glu Gly Thr Ala
210 215 220

Gln Ala Phe Phe Thr Asn Pro Gln Thr Lys Arg Ala Gln Glu Phe Leu
225 230 235 240

Asn Val Phe Asp Phe Ser Gln Phe Gly Ser Tyr Leu
245 250

<210> 274
<211> 206
<212> PRT
<213> Streptococcus pneumoniae

<400> 274

Met His Ile Ala Val Trp Gly Ile Leu Gly Ser Phe Leu Leu Gly Leu
1 5 10 15

Ile Val Ser Ile Ile Arg His Tyr Arg Ile Leu Val Leu Ala Gln Val
20 25 30

Ala Thr Ala Tyr Ile Glu Leu Ser Arg Asn Thr Pro Leu Leu Ile Gln
35 40 45

Leu Phe Phe Leu Tyr Phe Gly Leu Pro Arg Ile Gly Ile Val Leu Ser
50 55 60

Ser Glu Val Cys Ala Thr Leu Gly Leu Val Phe Leu Gly Gly Ser Tyr
65 70 75 80

Met Ala Glu Ser Phe Arg Ser Gly Leu Glu Ala Ile Ser Gln Thr Gln
85 90 95

Gln Glu Ile Gly Leu Ala Ile Gly Leu Thr Pro Leu Gln Val Phe Tyr
100 105 110

Tyr Val Val Leu Pro Gln Ala Thr Ala Val Ala Leu Pro Ser Phe Ser
115 120 125

Ala Asn Val Ile Phe Leu Ile Lys Glu Thr Ser Val Phe Ser Ala Val
    130   135   140

Ala Leu Ala Asp Leu Met Tyr Val Ala Lys Asp Leu Ile Gly Leu Tyr
145   150   155   160

Tyr Glu Thr Asp Ile Ala Leu Ala Met Leu Val Val Ala Tyr Leu Ile
                165   170   175

Met Leu Leu Pro Ile Ser Leu Val Phe Ser Trp Ile Glu Arg Arg Leu
            180   185   190

Arg His Ala Gly Phe Gly Asn Pro Ser Thr Leu Ser Arg Lys
        195   200   205

<210> 275
<211> 461
<212> PRT
<213> Streptococcus pneumoniae

<400> 275

Met Gly Leu Glu Leu Arg Ala Ile Gln Ser Pro Ile Phe Ser Glu Pro
1   5   10   15

Phe Asp Phe Thr Phe His Ala Gln Ala Phe Thr Leu Leu Val Gly Ser
            20   25   30

Ser Gly Ser Gly Lys Ser Ser Leu Phe Gln Met Ile Ala Gln Val Ser
        35   40   45

Ser Leu Pro Tyr Ser Gly Gln Val Leu Ile Asp Gly Ser Glu Val Ser
    50   55   60

Gln Leu Ser Ile Val Glu Arg Val Gln Thr Val Gly Ile Leu Leu Gln
65   70   75   80

Asn Pro Asn His Gln Phe Thr Met Glu Ser Leu Phe Glu Glu Leu Val
                85   90   95

Phe Thr Met Glu Asn Ile Gly Tyr His Leu Gln Glu Ile Asp Ser Lys
            100   105   110

Ile Ala Glu Val Val Gln Gln Cys Arg Cys Lys Asp Ile Leu His Arg
        115   120   125

Leu Ile His His Leu Ser Gly Gly Glu Lys Gln Lys Ala Ala Leu Ala
    130   135   140

Val Leu Phe Ala Met Asn Pro Arg Val Tyr Leu Leu Asp Glu Pro Phe
145   150   155   160

Ala Ser Ile Asp Arg Lys Ser Arg Ile Glu Ile Leu Glu Ile Leu Lys
                165   170   175

Glu Leu Val Tyr Asp Gly Lys Thr Val Ile Leu Cys Asp His Asp Leu
            180   185   190

Ser Asp Tyr Lys Ala Tyr Ile Asp His Met Val Glu Leu Arg Asp Gly
        195   200   205

Lys Leu Arg Glu Val Phe Gln Ile Pro Ser Tyr Glu Met Thr Gln Val
    210   215   220

Ala Ser Lys Glu Val Ala Ser Ser Pro Glu Leu Phe His Met Asn Arg
225   230   235   240

Val Thr Gly Glu Leu Gly Asn Arg Pro Leu Phe Ser Ile Ala Asp Phe
                245   250   255

Thr Phe Tyr Gln Gly Ile Ser Cys Ile Leu Gly Asp Asn Gly Val Gly
            260   265   270

Lys Ser Thr Leu Phe Arg Ser Ile Leu Gln Phe Gln Lys Tyr Lys Gly
        275   280   285

Ser Ile Thr Trp Lys Gly Ser Val Leu Lys Lys Lys Lys Ser Leu Tyr
    290   295   300

Arg Asp Leu Thr Gly Val Val Gln Glu Ala Glu Lys Gln Phe Ile Arg
305   310   315   320

Val Ser Leu Arg Glu Glu Leu Gln Leu Asp Gly Pro Asp Ser Glu Arg

325 330 335

Asn Gln Arg Ile Phe Gln Ala Leu Arg Tyr Phe Asp Leu Glu Gln Ala
340 345 350

Val Asp Lys Ser Pro Tyr Gln Leu Ser Gly Gly Gln Gln Lys Ile Leu
355 360 365

Gln Leu Leu Thr Ile Leu Thr Ser Lys Ala Ser Val Ile Leu Leu Asp
370 375 380

Glu Pro Phe Ala Gly Leu Asp Asp Arg Ala Cys His Tyr Phe Cys Lys
385 390 395 400

Trp Ile Val Glu Glu Arg Asn Gln Gly Arg Ser Phe Leu Leu Ile Ser
405 410 415

His Arg Leu Asp Pro Leu Ile Ser Val Val Asp Tyr Trp Ile Glu Met
420 425 430

Thr Ser Gln Gly Leu Arg His Val Lys Glu Val Thr Ile Thr Lys Pro
435 440 445

Leu Thr Ser Gln Ser Ser Asn Thr Gln Gly Glu Val Arg
450 455 460

<210> 276
<211> 397
<212> PRT
<213> Streptococcus pneumoniae

<400> 276

Met Trp Tyr Asn Arg Ala Met Lys His Phe Asp Thr Ile Val Ile Gly
1 5 10 15

Gly Gly Pro Ala Gly Met Met Ala Thr Ile Ser Ser Ser Phe Tyr Gly
20 25 30

Gln Lys Thr Leu Leu Ile Glu Lys Asn Arg Lys Leu Gly Lys Lys Leu
35 40 45

Ala Gly Thr Gly Gly Gly Arg Cys Asn Val Thr Asn Asn Gly Ser Leu

50 55 60

Asp Asn Leu Leu Ala Gly Ile Pro Gly Asn Gly Arg Phe Leu Tyr Ser
65 70 75 80

Val Phe Ser Gln Phe Asp Asn His Asp Ile Ile Asn Phe Phe Thr Glu
85 90 95

Asn Gly Val Lys Leu Lys Val Glu Asp His Gly Arg Val Phe Pro Ala
100 105 110

Ser Asp Lys Ser Arg Thr Ile Ile Glu Ala Leu Glu Lys Lys Ile Thr
115 120 125

Glu Leu Gly Gly Gln Val Ala Thr Gln Ile Glu Ile Val Ser Val Lys
130 135 140

Lys Val Asp Asp Gln Phe Val Leu Lys Ser Ala Asp Gln Thr Phe Thr
145 150 155 160

Cys Glu Lys Leu Ile Val Thr Thr Gly Gly Lys Ser Tyr Pro Ser Thr
165 170 175

Gly Ser Thr Gly Phe Gly His Glu Ile Ala Arg His Phe Lys His Thr
180 185 190

Ile Thr Asp Leu Glu Ala Ala Glu Ser Pro Leu Leu Thr Asp Phe Pro
195 200 205

His Lys Ala Leu Gln Gly Ile Ser Leu Asp Asp Val Thr Leu Ser Tyr
210 215 220

Gly Lys His Val Ile Thr His Asp Leu Leu Phe Thr His Phe Gly Leu
225 230 235 240

Ser Gly Pro Ala Ala Leu Arg Met Ser Ser Phe Val Lys Gly Gly Glu
245 250 255

Val Leu Ser Leu Asp Val Leu Pro Gln Leu Ser Glu Lys Asp Leu Val
260 265 270

Thr Phe Leu Glu Glu Asn Arg Glu Lys Ser Leu Lys Asn Ala Leu Lys
275 280 285

Thr Leu Leu Pro Glu Arg Leu Ala Glu Phe Phe Val Gln Gly Tyr Pro
290 295 300

Glu Lys Val Lys Gln Leu Thr Glu Lys Glu Arg Glu Gln Leu Val Gln
305 310 315 320

Ser Ile Lys Glu Leu Lys Ile Pro Val Thr Gly Lys Met Ser Leu Ala
325 330 335

Lys Ser Phe Val Thr Lys Gly Gly Val Ser Leu Lys Glu Ile Asn Pro
340 345 350

Lys Thr Leu Glu Ser Lys Leu Val Pro Gly Leu His Phe Ala Gly Glu
355 360 365

Val Met Asp Ile Asn Ala His Thr Gly Gly Phe Asn Ile Thr Ser Ala
370 375 380

Leu Cys Thr Gly Trp Val Ala Gly Ser Leu His Tyr Asp
385 390 395

<210> 277
<211> 83
<212> PRT
<213> Streptococcus pneumoniae

<400> 277

Met Lys Lys Lys Phe Ala Leu Ser Phe Val Ala Leu Ala Ser Val Ala
1 5 10 15

Leu Leu Ala Ala Cys Gly Glu Val Lys Ser Gly Ala Val Asn Thr Ala
20 25 30

Gly Asn Ser Val Glu Glu Lys Thr Ile Lys Ile Gly Phe Asn Phe Glu
35 40 45

Glu Ser Gly Ser Leu Ala Ala Tyr Gly Thr Ala Glu Gln Lys Gly Ala
50 55 60

Gln Leu Ala Val Asp Glu Ile Asn Ala Ala Val Val Ser Met Glu Asn
65 70 75 80

Lys Ser Lys

<210> 278
<211> 254
<212> PRT
<213> Streptococcus pneumoniae

<400> 278

Met Ala Leu Leu Glu Val Lys Gln Leu Thr Lys His Phe Gly Gly Leu
1 5 10 15

Thr Ala Val Gly Asp Val Thr Leu Glu Leu Asn Glu Gly Glu Leu Val
20 25 30

Gly Leu Ile Gly Pro Asn Gly Ala Gly Lys Thr Thr Leu Phe Asn Leu
35 40 45

Leu Thr Gly Val Tyr Glu Pro Ser Glu Gly Thr Val Thr Leu Asp Gly
50 55 60

His Leu Leu Asn Gly Lys Ser Pro Tyr Lys Ile Ala Ser Leu Gly Leu
65 70 75 80

Gly Arg Thr Phe Gln Asn Ile Arg Leu Phe Lys Asp Leu Thr Val Leu
85 90 95

Asp Asn Val Leu Ile Ala Phe Gly Asn His His Lys Gln His Val Phe
100 105 110

Thr Ser Phe Leu Arg Leu Pro Ala Phe Tyr Lys Ser Glu Lys Glu Leu
115 120 125

Lys Ala Lys Ala Leu Glu Leu Leu Lys Ile Phe Asp Leu Asp Gly Asp
130 135 140

Ala Glu Thr Leu Ala Lys Asn Leu Ser Tyr Gly Gln Gln Arg Arg Leu
145 150 155 160

Glu Ile Val Arg Ala Leu Ala Thr Glu Pro Lys Ile Leu Phe Leu Asp
165 170 175

Glu Pro Ala Ala Gly Met Asn Pro Gln Glu Thr Ala Glu Leu Thr Glu
180 185 190

Leu Ile Arg Arg Ile Lys Asp Glu Phe Lys Ile Thr Ile Met Leu Ile
195 200 205

Glu His Asp Met Asn Leu Val Met Glu Val Thr Glu Arg Ile Tyr Val
210 215 220

Leu Glu Tyr Gly Arg Leu Ile Ala Gln Gly Thr Pro Asp Glu Ile Lys
225 230 235 240

Thr Asn Lys Arg Val Ile Glu Ala Tyr Leu Gly Gly Glu Ala
245 250

<210> 279
<211> 230
<212> PRT
<213> Streptococcus pneumoniae

<400> 279

Met Ser Ile Ile Glu Met Arg Asp Val Val Lys Lys Tyr Asp Asn Gly
1 5 10 15

Thr Thr Ala Leu Arg Gly Val Ser Val Ser Val Gln Pro Gly Glu Phe
20 25 30

Ala Tyr Ile Val Gly Pro Ser Gly Ala Gly Lys Ser Thr Phe Ile Arg
35 40 45

Ser Leu Tyr Arg Glu Val Lys Ile Asp Lys Gly Ser Leu Ser Val Ala
50 55 60

Gly Phe Asn Leu Val Lys Ile Lys Lys Lys Asp Val Pro Leu Leu Arg
65 70 75 80

Arg Ser Val Gly Val Val Phe Gln Asp Tyr Lys Leu Leu Pro Lys Lys
85 90 95

Thr Val Tyr Glu Asn Ile Ala Tyr Ala Met Glu Val Ile Gly Glu Asn
100 105 110

Arg Arg Asn Ile Lys Arg Arg Val Met Glu Val Leu Asp Leu Val Gly
115 120 125

Leu Lys His Lys Val Arg Ser Phe Pro Asn Glu Leu Ser Gly Gly Glu
130 135 140

Gln Gln Arg Ile Ala Ile Ala Arg Ala Ile Val Asn Asn Pro Lys Val
145 150 155 160

Leu Ile Ala Asp Glu Pro Thr Gly Asn Leu Asp Pro Asp Asn Ser Trp
165 170 175

Glu Ile Met Asn Leu Leu Glu Arg Ile Asn Leu Gln Gly Thr Thr Ile
180 185 190

Leu Met Ala Thr His Asn Ser Gln Ile Val Asn Thr Leu Arg His Arg
195 200 205

Val Ile Ala Ile Glu Asn Gly Arg Val Val Arg Asp Glu Ser Lys Gly
210 215 220

Glu Tyr Gly Tyr Asp Asp
225 230

<210> 280
<211> 726
<212> PRT
<213> Streptococcus pneumoniae

<400> 280

Met Met Lys Asp Thr Phe Lys Asn Val Leu Ser Phe Glu Phe Trp Gln
1 5 10 15

Lys Phe Gly Lys Ala Leu Met Val Val Ile Ala Val Met Pro Ala Ala
20 25 30

Gly Leu Met Ile Ser Ile Gly Lys Ser Ile Val Met Ile Asn Pro Thr
35 40 45

```
Phe Ala Pro Leu Val Ile Thr Gly Gly Ile Leu Glu Gln Ile Gly Trp
    50                  55                  60

Gly Val Ile Gly Asn Leu His Ile Leu Phe Ala Leu Ala Ile Gly Gly
65                  70                  75                  80

Ser Trp Ala Lys Glu Arg Ala Gly Gly Ala Phe Ala Ala Gly Leu Ala
                85                  90                  95

Phe Ile Leu Ile Asn Arg Ile Thr Gly Thr Ile Phe Gly Val Ser Gly
            100                 105                 110

Asp Met Leu Lys Asn Pro Asp Ala Met Val Thr Thr Phe Phe Gly Gly
        115                 120                 125

Ser Ile Lys Val Ala Asp Tyr Phe Ile Ser Val Leu Glu Ala Pro Ala
    130                 135                 140

Leu Asn Met Gly Val Phe Val Gly Ile Ile Ser Gly Phe Val Gly Ala
145                 150                 155                 160

Thr Ala Tyr Asn Lys Tyr Tyr Asn Phe Arg Lys Leu Pro Asp Ala Leu
                165                 170                 175

Ser Phe Phe Asn Gly Lys Arg Phe Val Pro Phe Val Val Ile Leu Arg
            180                 185                 190

Ser Ala Ile Ala Ala Ile Leu Leu Ala Ala Phe Trp Pro Val Val Gln
        195                 200                 205

Thr Gly Ile Asn Asn Phe Gly Ile Trp Ile Ala Asn Ser Gln Glu Thr
    210                 215                 220

Ala Pro Ile Leu Ala Pro Phe Leu Tyr Gly Thr Leu Glu Arg Leu Leu
225                 230                 235                 240

Leu Pro Phe Gly Leu His His Met Leu Thr Ile Pro Met Asn Tyr Thr
                245                 250                 255

Ala Leu Gly Gly Thr Tyr Asp Ile Leu Thr Gly Ala Ala Lys Gly Thr
            260                 265                 270
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Gln Val Phe Gly Gln Asp Pro Leu Trp Leu Ala Trp Val Thr Asp Leu
        275                 280                 285

Val Asn Leu Lys Gly Thr Asp Ala Ser Gln Tyr Gln His Leu Leu Asp
    290                 295                 300

Thr Val His Pro Ala Arg Phe Lys Val Gly Gln Met Ile Gly Ser Phe
305                 310                 315                 320

Gly Ile Leu Met Gly Val Ile Val Ala Ile Tyr Arg Asn Val Asp Ala
                325                 330                 335

Asp Lys Lys His Lys Tyr Lys Gly Met Met Ile Ala Thr Ala Leu Ala
            340                 345                 350

Thr Phe Leu Thr Gly Val Thr Glu Pro Ile Glu Tyr Met Phe Met Phe
        355                 360                 365

Ile Ala Thr Pro Met Tyr Leu Val Tyr Ser Leu Val Gln Gly Ala Ala
    370                 375                 380

Phe Ala Met Ala Asp Val Val Asn Leu Arg Met His Ser Phe Gly Ser
385                 390                 395                 400

Ile Glu Phe Leu Thr Arg Thr Pro Ile Ala Ile Ser Ala Gly Ile Gly
                405                 410                 415

Met Asp Ile Val Asn Phe Val Trp Val Thr Val Leu Phe Ala Val Ile
            420                 425                 430

Met Tyr Phe Ile Ala Asn Phe Met Ile Gln Lys Phe Asn Tyr Ala Thr
        435                 440                 445

Pro Gly Arg Asn Gly Asn Tyr Glu Thr Ala Glu Gly Ser Glu Glu Thr
    450                 455                 460

Ser Ser Glu Val Lys Val Ala Ala Gly Ser Gln Ala Val Asn Ile Ile
465                 470                 475                 480

Asn Leu Leu Gly Gly Arg Val Asn Ile Val Asp Val Asp Ala Cys Met
                485                 490                 495
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Thr Arg Leu Arg Val Thr Val Lys Asp Ala Asp Lys Val Gly Asn Ala
500 505 510

Glu Gln Trp Lys Ala Glu Gly Ala Met Gly Leu Val Met Lys Gly Gln
515 520 525

Gly Val Gln Ala Ile Tyr Gly Pro Lys Ala Asp Ile Leu Lys Ser Asp
530 535 540

Ile Gln Asp Ile Leu Asp Ser Gly Glu Ile Ile Pro Glu Thr Leu Pro
545 550 555 560

Ser Gln Met Thr Glu Ala Gln Gln Asn Thr Val His Phe Lys Asp Leu
565 570 575

Thr Glu Glu Val Tyr Ser Val Ala Asp Gly Gln Val Val Ala Leu Glu
580 585 590

Gln Val Lys Asp Pro Val Phe Ala Gln Lys Met Met Gly Asp Gly Phe
595 600 605

Ala Val Glu Pro Ala Asn Gly Asn Ile Val Ser Pro Val Ser Gly Thr
610 615 620

Val Ser Ser Ile Phe Pro Thr Lys His Ala Phe Gly Ile Val Thr Glu
625 630 635 640

Ala Gly Leu Glu Val Leu Val His Ile Gly Leu Asp Thr Val Ser Leu
645 650 655

Glu Gly Lys Pro Phe Thr Val His Val Ala Glu Gly Gln Lys Val Ala
660 665 670

Ala Gly Asp Leu Leu Val Thr Ala Asp Leu Asp Ala Ile Arg Ala Ala
675 680 685

Gly Arg Glu Thr Ser Thr Val Val Val Phe Thr Asn Gly Asp Ala Ile
690 695 700

Lys Ser Val Lys Leu Glu Lys Thr Gly Ser Leu Ala Ala Lys Thr Ala

705 710 715 720

Val Ala Lys Val Glu Leu
725

<210> 281
<211> 513
<212> PRT
<213> Streptococcus pneumoniae

<400> 281

Met Ser Ile Leu Glu Val Lys Asn Leu Ser His Gly Phe Gly Asp Arg
1 5 10 15

Ala Ile Phe Glu Asp Val Ser Phe Arg Leu Leu Lys Gly Glu His Ile
20 25 30

Gly Leu Val Gly Ala Asn Gly Glu Gly Lys Ser Thr Phe Met Ser Ile
35 40 45

Val Thr Gly Lys Met Leu Pro Asp Glu Gly Lys Val Glu Trp Ser Lys
50 55 60

Tyr Val Thr Ala Gly Tyr Leu Asp Gln His Ser Val Leu Ala Glu Arg
65 70 75 80

Gln Ser Val Arg Asp Val Leu Arg Thr Ala Phe Asp Glu Leu Phe Lys
85 90 95

Ala Glu Ala Arg Ile Asn Asp Leu Tyr Met Lys Met Ala Glu Asp Gly
100 105 110

Ala Asp Val Asp Ala Leu Met Glu Glu Val Gly Glu Leu Gln Asp Arg
115 120 125

Leu Glu Ser Arg Asp Phe Tyr Thr Leu Asp Ala Lys Ile Asp Glu Val
130 135 140

Ala Arg Ala Leu Gly Val Met Asp Phe Gly Met Asp Thr Asp Val Thr
145 150 155 160

Ser Leu Ser Gly Gly Gln Arg Thr Lys Val Leu Leu Ala Lys Leu Leu

165 170 175

Leu Glu Lys Pro Asp Ile Leu Leu Leu Asp Glu Pro Thr Asn Tyr Leu
180 185 190

Asp Ala Glu His Ile Asp Trp Leu Lys Arg Tyr Leu Gln Asn Tyr Glu
195 200 205

Asn Ala Phe Val Leu Ile Ser His Asp Ile Pro Phe Leu Asn Asp Val
210 215 220

Ile Asn Ile Val Tyr His Val Glu Asn Gln Gln Leu Thr Arg Tyr Ser
225 230 235 240

Gly Asp Tyr Tyr Gln Phe Gln Glu Val Tyr Ala Met Lys Lys Ser Gln
245 250 255

Leu Glu Ala Ala Tyr Glu Arg Gln Gln Lys Glu Ile Ala Asp Leu Lys
260 265 270

Asp Phe Val Ala Arg Asn Lys Ala Arg Val Ala Thr Arg Asn Met Ala
275 280 285

Met Ser Arg Gln Lys Lys Leu Asp Lys Met Asp Ile Ile Glu Leu Gln
290 295 300

Ser Glu Lys Pro Lys Pro Ser Phe Asp Phe Lys Pro Ala Arg Thr Pro
305 310 315 320

Gly Arg Phe Ile Phe Gln Ala Lys Asn Leu Gln Ile Gly Tyr Asp Arg
325 330 335

Pro Leu Thr Lys Pro Leu Asn Leu Thr Phe Glu Arg Asn Gln Lys Val
340 345 350

Ala Ile Ile Gly Ala Asn Gly Ile Gly Lys Thr Thr Leu Leu Lys Ser
355 360 365

Leu Leu Gly Ile Ile Ser Pro Ile Ala Gly Glu Val Glu Arg Gly Asp
370 375 380

Tyr Leu Glu Leu Gly Tyr Phe Glu Gln Glu Val Glu Gly Gly Asn Arg
385 390 395 400

Gln Thr Pro Leu Glu Ala Val Trp Asn Ala Phe Pro Ala Leu Asn Gln
405 410 415

Ala Glu Val Arg Ala Ala Leu Ala Arg Cys Gly Leu Thr Thr Lys His
420 425 430

Ile Glu Ser Gln Ile Gln Val Leu Ser Gly Gly Glu Gln Ala Lys Val
435 440 445

Arg Phe Cys Leu Leu Met Asn Arg Glu Asn Asn Val Leu Val Leu Asp
450 455 460

Glu Pro Thr Asn His Leu Asp Val Asp Ala Lys Asp Glu Leu Lys Arg
465 470 475 480

Ala Leu Lys Glu Tyr Arg Gly Ser Ile Leu Met Val Cys His Glu Pro
485 490 495

Asp Phe Tyr Glu Gly Trp Ile Asp Gln Ile Trp Asp Phe Asn Asn Leu
500 505 510

Thr

<210> 282
<211> 267
<212> PRT
<213> Streptococcus pneumoniae

<400> 282

Met Lys Lys Leu Ala Thr Leu Leu Leu Leu Ser Thr Val Ala Leu Ala
1 5 10 15

Gly Cys Ser Ser Val Gln Arg Ser Leu Arg Gly Asp Asp Tyr Val Asp
20 25 30

Ser Ser Leu Ala Ala Glu Glu Ser Ser Lys Val Ala Ala Gln Ser Ala
35 40 45

Lys Glu Leu Asn Asp Ala Leu Thr Asn Glu Asn Ala Asn Phe Pro Gln
50 55 60

Leu Ser Lys Glu Val Ala Glu Asp Glu Ala Glu Val Ile Phe His Thr
65 70 75 80

Ser Gln Gly Asp Ile Arg Ile Lys Leu Phe Pro Lys Leu Ala Pro Leu
85 90 95

Ala Val Glu Asn Phe Leu Thr His Ala Lys Glu Gly Tyr Tyr Asn Gly
100 105 110

Ile Thr Phe His Arg Val Ile Asp Gly Phe Met Val Gln Thr Gly Asp
115 120 125

Pro Lys Gly Asp Gly Thr Gly Gly Gln Ser Ile Trp His Asp Lys Asp
130 135 140

Lys Thr Lys Asp Lys Gly Thr Gly Phe Lys Asn Glu Ile Thr Pro Tyr
145 150 155 160

Leu Tyr Asn Ile Arg Gly Ala Leu Ala Met Ala Asn Thr Gly Gln Pro
165 170 175

Asn Thr Asn Gly Ser Gln Phe Phe Ile Asn Gln Asn Ser Thr Asp Thr
180 185 190

Ser Ser Lys Leu Pro Thr Ser Lys Tyr Pro Gln Lys Ile Ile Glu Ala
195 200 205

Tyr Lys Glu Gly Gly Asn Pro Ser Leu Asp Gly Lys His Pro Val Phe
210 215 220

Gly Gln Val Ile Asp Gly Met Asp Val Val Asp Lys Ile Ala Lys Ala
225 230 235 240

Glu Lys Asp Glu Lys Asp Lys Pro Thr Thr Ala Ile Thr Ile Asp Ser
245 250 255

Ile Glu Val Val Lys Asp Tyr Asp Phe Lys Ser
260 265

<210> 283
<211> 448
<212> PRT
<213> Streptococcus pneumoniae

<400> 283

Met Arg Glu Tyr Asp Ile Ile Ala Ile Gly Gly Gly Ser Gly Gly Ile
1 5 10 15

Ala Thr Met Asn Arg Ala Gly Glu His Gly Ala Lys Ala Ala Val Ile
20 25 30

Glu Glu Lys Lys Leu Gly Gly Thr Cys Val Asn Val Gly Cys Val Pro
35 40 45

Lys Lys Ile Met Trp Tyr Gly Ala Gln Ile Ala Glu Thr Phe His Gln
50 55 60

Phe Gly Glu Asp Tyr Gly Phe Lys Thr Thr Asp Leu Asn Phe Asp Phe
65 70 75 80

Ala Thr Leu Arg Arg Asn Arg Glu Ala Tyr Ile Asp Arg Ala Arg Ser
85 90 95

Ser Tyr Asp Gly Ser Phe Lys Arg Asn Gly Val Asp Leu Ile Glu Gly
100 105 110

His Ala Glu Phe Val Asp Ser His Thr Val Ser Val Asn Gly Glu Leu
115 120 125

Ile Arg Ala Lys His Ile Val Ile Ala Thr Gly Ala His Pro Ser Ile
130 135 140

Pro Asn Ile Pro Gly Ala Glu Leu Gly Gly Ser Ser Asp Asp Val Phe
145 150 155 160

Ala Trp Glu Glu Leu Pro Glu Ser Ile Ala Ile Leu Gly Ala Gly Tyr
165 170 175

Ile Ala Val Glu Leu Ala Gly Val Leu His Thr Phe Gly Val Lys Thr
180 185 190

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Asp Leu Phe Val Arg Arg Asp Arg Pro Leu Arg Gly Phe Asp Ser Tyr
        195                 200                 205

Ile Val Glu Gly Leu Val Lys Glu Met Glu Arg Thr Asn Leu Pro Leu
    210                 215                 220

His Thr His Lys Val Pro Val Lys Leu Glu Lys Thr Thr Asp Gly Ile
225                 230                 235                 240

Thr Ile His Phe Glu Asp Gly Thr Ser His Thr Ala Ser Gln Val Ile
                245                 250                 255

Trp Ala Thr Gly Arg Arg Pro Asn Val Lys Gly Leu Gln Leu Glu Lys
            260                 265                 270

Ala Gly Val Thr Leu Asn Glu Arg Gly Phe Ile Gln Val Asp Glu Tyr
        275                 280                 285

Gln Asn Thr Val Val Glu Gly Ile Tyr Ala Leu Gly Asp Val Thr Gly
    290                 295                 300

Glu Lys Glu Leu Thr Pro Val Ala Ile Lys Ala Gly Arg Thr Leu Ser
305                 310                 315                 320

Glu Arg Leu Phe Asn Gly Lys Thr Thr Ala Lys Met Asp Tyr Ser Thr
                325                 330                 335

Ile Pro Thr Val Val Phe Ser His Pro Ala Ile Gly Thr Val Gly Leu
            340                 345                 350

Thr Glu Glu Gln Ala Ile Lys Glu Tyr Gly Gln Asp Gln Ile Lys Val
        355                 360                 365

Tyr Lys Ser Ser Phe Ala Ser Met Tyr Ser Ala Cys Thr Cys Asn Arg
    370                 375                 380

Gln Glu Ser Arg Phe Lys Leu Ile Thr Ala Gly Ser Glu Glu Lys Val
385                 390                 395                 400

Val Gly Leu His Gly Ile Gly Tyr Gly Val Asp Glu Met Ile Gln Gly
                405                 410                 415
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Phe Ala Val Ala Ile Lys Met Gly Ala Thr Lys Ala Asp Phe Asp Ala
420 425 430

Thr Val Ala Ile His Pro Thr Ala Ser Glu Glu Phe Val Thr Met Arg
435 440 445

<210> 284
<211> 444
<212> PRT
<213> Streptococcus pneumoniae

<400> 284

Met Phe Ser Lys Leu Lys Lys Thr Trp Tyr Ala Asp Asp Phe Ser Tyr
1 5 10 15

Phe Ile Arg Asn Phe Gly Val Phe Thr Leu Ile Phe Ser Thr Met Thr
20 25 30

Leu Ile Ile Leu Gln Val Met His Ser Ser Leu Tyr Thr Ser Val Asp
35 40 45

Asp Lys Leu His Gly Leu Ser Glu Asn Pro Gln Ala Val Ile Gln Leu
50 55 60

Ala Ile Asn Arg Ala Thr Glu Glu Ile Lys Asp Leu Glu Asn Ala Arg
65 70 75 80

Ala Asp Ala Ser Lys Val Glu Ile Lys Pro Asn Val Ser Ser Asn Thr
85 90 95

Glu Val Ile Leu Phe Asp Lys Asp Phe Thr Gln Leu Leu Ser Gly Asn
100 105 110

Arg Phe Leu Gly Leu Asp Lys Ile Lys Leu Glu Lys Lys Glu Leu Gly
115 120 125

His Ile Tyr Gln Ile Gln Val Phe Asn Ser Tyr Gly Gln Glu Glu Ile
130 135 140

Tyr Arg Val Ile Leu Met Glu Thr Asn Ile Ser Ser Val Ser Thr Asn
145 150 155 160

Ile Lys Tyr Ala Ala Val Leu Ile Asn Thr Ser Gln Leu Glu Gln Ala
165 170 175

Ser Gln Lys His Glu Gln Leu Ile Val Val Val Met Ala Ser Phe Trp
180 185 190

Ile Leu Ser Leu Leu Ala Ser Leu Tyr Leu Ala Arg Val Ser Val Arg
195 200 205

Pro Leu Leu Glu Ser Met Gln Lys Gln Gln Ser Phe Val Glu Asn Ala
210 215 220

Ser His Glu Leu Arg Thr Pro Leu Ala Val Leu Gln Asn Arg Leu Glu
225 230 235 240

Thr Leu Phe Arg Lys Pro Glu Ala Thr Ile Met Asp Val Ser Glu Ser
245 250 255

Ile Ala Ser Ser Leu Glu Glu Val Arg Asn Met Arg Phe Leu Thr Thr
260 265 270

Ser Leu Leu Asn Leu Ala Arg Arg Asp Asp Gly Ile Lys Pro Glu Leu
275 280 285

Ala Glu Val Pro Thr Ser Phe Phe Asn Thr Thr Phe Thr Asn Tyr Glu
290 295 300

Met Ile Ala Ser Glu Asn Asn Arg Val Phe Arg Phe Glu Asn Arg Ile
305 310 315 320

His Arg Thr Ile Val Thr Asp Gln Leu Leu Leu Lys Gln Leu Met Thr
325 330 335

Ile Leu Phe Asp Asn Ala Val Lys Tyr Thr Glu Glu Asp Gly Glu Ile
340 345 350

Asp Phe Leu Ile Ser Ala Thr Asp Arg Asn Leu Tyr Leu Leu Val Ser
355 360 365

Asp Asn Gly Ile Gly Ile Ser Thr Glu Asp Lys Lys Lys Ile Phe Asp

370 375 380

Arg Phe Tyr Arg Val Asp Lys Ala Arg Thr Arg Gln Lys Gly Gly Phe
385 390 395 400

Gly Leu Gly Leu Ser Leu Ala Lys Gln Ile Val Asp Ala Leu Lys Gly
405 410 415

Thr Val Thr Val Lys Asp Asn Lys Pro Lys Gly Thr Ile Phe Glu Val
420 425 430

Lys Ile Ala Ile Gln Thr Pro Ser Lys Lys Lys Lys
435 440

<210> 285
<211> 356
<212> PRT
<213> Streptococcus pneumoniae

<400> 285

Met Ile Leu Ser Leu Thr Val His Thr Tyr Phe Ile Ile Phe Ser Ala
1 5 10 15

Glu Asn Tyr Tyr Arg Lys Val Thr Lys Arg Ile Lys Ser Leu Phe Ile
20 25 30

Phe Lys Ala Trp Leu Ile Leu Glu Lys Cys Gly Ile Ile Phe Leu Met
35 40 45

Glu Lys Ile Val Ile Thr Ala Thr Ala Glu Ser Ile Glu Gln Val Glu
50 55 60

Gln Leu Leu Glu Ala Gly Val Asp Arg Ile Tyr Val Gly Glu Lys Asp
65 70 75 80

Phe Gly Leu Arg Leu Pro Thr Thr Phe Ser Tyr Asp Gln Leu Arg Glu
85 90 95

Ile Ala Lys Leu Val His Asp Ala Gly Lys Glu Leu Ile Val Ala Val
100 105 110

Asn Ala Leu Met His Gln Asp Met Met Asp Arg Ile Lys Pro Phe Leu

115 120 125

Asn Phe Leu Glu Glu Ile Lys Thr Asp Tyr Ile Thr Ile Gly Asp Ala
130 135 140

Gly Val Phe Tyr Val Val Asn Arg Asp Gly Tyr Ser Phe Lys Thr Ile
145 150 155 160

Tyr Asp Ala Ser Thr Met Val Thr Ser Ser Arg Gln Ile Asn Phe Trp
165 170 175

Gly Gln Lys Ala Gly Ala Ser Glu Ala Val Leu Ala Arg Glu Ile Pro
180 185 190

Ser Ala Glu Leu Phe Lys Met Pro Glu Ile Leu Glu Ile Pro Ala Glu
195 200 205

Val Leu Val Tyr Gly Ala Ser Val Ile His His Ser Lys Arg Pro Leu
210 215 220

Leu Gln Asn Tyr Tyr Asn Phe Thr His Ile Asp Asp Glu Lys Thr His
225 230 235 240

Lys Arg Asp Leu Phe Leu Ala Glu Pro Ser Asp Pro Glu Ser His Tyr
245 250 255

Ser Ile Phe Glu Asp Asn His Gly Thr His Ile Phe Ala Asn Asn Asp
260 265 270

Leu Asp Leu Met Ile Lys Leu Thr Glu Leu Val Glu His Gly Phe Thr
275 280 285

Arg Trp Lys Leu Glu Gly Leu Tyr Thr Pro Gly Gln Asn Phe Val Glu
290 295 300

Ile Ala Lys Leu Phe Ile Gln Ala Arg Ser Leu Ile Gln Glu Gly Asn
305 310 315 320

Phe Ser His Ala Gln Ala Phe Leu Leu Asp Glu Glu Val Arg Lys Leu
325 330 335

His Pro Lys Asn Arg Phe Leu Asp Thr Gly Phe Tyr Asp Tyr Asp Pro
340 345 350

Asp Met Val Arg
355

<210> 286
<211> 229
<212> PRT
<213> Streptococcus pneumoniae

<400> 286

Met Thr Met Asn Phe Ser Phe Leu Pro Lys Tyr Leu Pro Tyr Phe Asn
1 5 10 15

Tyr Gly Ala Val Val Thr Ile Leu Ile Ser Ile Cys Val Ile Phe Leu
20 25 30

Gly Thr Ile Leu Gly Val Val Leu Ala Phe Gly Gln Arg Ser Lys Phe
35 40 45

Lys Pro Leu Val Trp Leu Ala Asn Leu Tyr Val Trp Ile Phe Arg Gly
50 55 60

Thr Pro Met Met Val Gln Ile Met Ile Ala Phe Ala Leu Met His Ile
65 70 75 80

Asn Ala Pro Thr Ile Gln Ile Gly Ile Leu Gly Val Asp Phe Ser Arg
85 90 95

Leu Ile Pro Gly Ile Leu Ile Ile Ser Met Asn Ser Gly Ala Tyr Val
100 105 110

Ser Glu Thr Val Arg Ala Gly Ile Asn Ala Val Pro Lys Gly Gln Leu
115 120 125

Glu Ala Ala Tyr Ser Leu Gly Ile Arg Pro Lys Asn Ala Met Arg Tyr
130 135 140

Val Ile Leu Pro Gln Ala Val Lys Asn Ile Leu Pro Ala Leu Gly Asn
145 150 155 160

Glu Phe Ile Thr Ile Ile Lys Asp Ser Ser Leu Leu Ser Ala Ile Gly
165 170 175

Val Met Glu Leu Trp Asn Gly Ala Thr Thr Val Ser Thr Thr Thr Tyr
180 185 190

Leu Pro Leu Thr Pro Leu Leu Phe Ala Ala Phe Tyr Tyr Leu Ile Met
195 200 205

Thr Ser Ile Leu Thr Val Ala Leu Lys Ala Phe Glu Lys His Met Gly
210 215 220

Gln Gly Asp Lys Lys
225

<210> 287
<211> 244
<212> PRT
<213> Streptococcus pneumoniae

<400> 287

Met Thr Glu Thr Leu Ile Lys Ile Glu Asn Leu His Lys Ser Phe Gly
1 5 10 15

Lys Asn Glu Val Leu Lys Gly Ile Asn Leu Glu Ile Lys Arg Gly Glu
20 25 30

Val Val Val Ile Ile Gly Pro Ser Gly Ser Gly Lys Ser Thr Leu Leu
35 40 45

Arg Ser Met Asn Leu Leu Glu Glu Ala Thr Lys Gly Lys Val Ile Phe
50 55 60

Glu Gly Val Asp Ile Thr Asp Lys Lys Asn Asp Leu Phe Ala Met Arg
65 70 75 80

Glu Lys Met Gly Met Val Phe Gln Gln Phe Asn Leu Phe Pro Asn Met
85 90 95

Thr Val Met Glu Asn Ile Thr Leu Ser Pro Ile Lys Thr Lys Gly Asp
100 105 110

Ser Lys Ala Val Ala Glu Lys Arg Ala Gln Glu Leu Leu Glu Lys Val
115 120 125

Gly Leu Pro Asp Lys Ala Asp Ala Tyr Pro Gln Ser Leu Ser Gly Gly
130 135 140

Gln Gln Gln Arg Ile Ala Ile Ala Arg Gly Leu Ala Met Glu Pro Asp
145 150 155 160

Val Leu Leu Phe Asp Glu Pro Thr Ser Ala Leu Asp Pro Glu Met Val
165 170 175

Gly Glu Val Leu Ala Val Met Gln Asp Leu Ala Lys Ser Gly Met Thr
180 185 190

Met Val Ile Val Thr His Glu Met Gly Phe Ala Arg Glu Val Ala Asp
195 200 205

Arg Val Ile Phe Met Ala Asp Gly Val Val Val Glu Asp Gly Thr Pro
210 215 220

Glu Gln Ile Phe Glu Gln Thr Gln Gly Gln Arg Thr Lys Asp Phe Leu
225 230 235 240

Ser Lys Val Leu

<210> 288
<211> 78
<212> PRT
<213> Streptococcus pneumoniae

<400> 288

Met Lys Ile Leu Lys Arg Tyr Ile Leu Glu Leu Cys Phe Ile Leu Ser
1 5 10 15

Phe Ala Leu Pro Phe Ile Lys Gly Thr Asn Ala Asp Asn Gly Arg Cys
20 25 30

Phe Val Glu Thr Tyr Tyr Gly Phe Thr Phe Leu Met Glu His Ala Ile
35 40 45

```
Val Thr Ala Val Phe Ile Cys Ser Phe Leu Ile Ala Phe Leu Leu Lys
    50                  55                  60

Asn Asp Gly Arg Asn Gly Leu Leu Arg Val Val Ile Ala Phe
65                  70                  75

<210>  289
<211>  511
<212>  PRT
<213>  Streptococcus pneumoniae

<400>  289

Met Ala His Glu Asn Val Ile Glu Met Arg Asp Ile Thr Lys Val Phe
1               5                   10                  15

Gly Gly Phe Val Ala Asn Asp Lys Ile Asn Leu His Leu Arg Lys Gly
            20                  25                  30

Glu Ile His Ala Leu Leu Gly Glu Asn Gly Ala Gly Lys Ser Thr Leu
        35                  40                  45

Met Asn Met Leu Ala Gly Leu Leu Glu Pro Thr Ser Gly Glu Ile Ala
    50                  55                  60

Val Asn Gly Gln Val Val Asn Leu Asp Ser Pro Ser Lys Ala Ala Ser
65                  70                  75                  80

Leu Gly Ile Gly Met Val His Gln His Phe Met Leu Val Glu Ala Phe
                85                  90                  95

Thr Val Ala Glu Asn Ile Ile Leu Gly Ser Glu Leu Thr Lys Asn Gly
            100                 105                 110

Val Leu Asp Ile Ala Gly Ala Ser Lys Glu Ile Lys Ala Leu Ser Glu
        115                 120                 125

Arg Tyr Gly Leu Ala Val Asp Pro Ser Ala Lys Val Ala Asp Ile Ser
    130                 135                 140

Val Gly Ala Gln Gln Arg Val Glu Ile Leu Lys Thr Leu Tyr Arg Gly
145                 150                 155                 160
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Ala Asp Ile Leu Ile Phe Asp Glu Pro Thr Ala Val Leu Thr Pro Ser
165 170 175

Glu Ile Asp Glu Leu Met Ala Ile Met Lys Asn Leu Val Lys Glu Gly
180 185 190

Lys Ser Ile Ile Leu Ile Thr His Lys Leu Asp Glu Ile Arg Ala Val
195 200 205

Ser Asp Arg Val Thr Val Ile Arg Arg Gly Lys Ser Ile Glu Thr Val
210 215 220

Glu Ile Ala Gly Ala Thr Asn Ala Asp Leu Ala Glu Met Met Val Gly
225 230 235 240

Arg Ser Val Ser Phe Lys Thr Glu Lys Gln Ala Ser Lys Pro Lys Glu
245 250 255

Val Val Leu Ser Ile Lys Asp Leu Val Val Asn Glu Asn Arg Gly Val
260 265 270

Pro Ala Val Lys Asn Leu Ser Leu Asp Val Arg Ala Gly Glu Ile Val
275 280 285

Gly Ile Ala Gly Ile Asp Gly Asn Gly Gln Ser Glu Leu Ile Gln Ala
290 295 300

Ile Thr Gly Leu Arg Lys Val Glu Ser Gly Ser Ile Glu Leu Lys Gly
305 310 315 320

Asp Ser Ile Val Gly Leu His Pro Arg Gln Ile Thr Glu Leu Ser Val
325 330 335

Gly His Val Pro Glu Asp Arg His Arg Asp Gly Leu Ile Leu Glu Met
340 345 350

Met Ile Ser Glu Asn Ile Ala Leu Gln Thr Tyr Tyr Lys Glu Pro His
355 360 365

Ser Lys Asn Gly Ile Leu Asn Tyr Ser Asn Ile Thr Ser Tyr Ala Lys
370 375 380

Lys Leu Met Glu Glu Phe Asp Val Arg Ala Ala Ser Glu Leu Val Pro
385 390 395 400

Ala Ala Ala Leu Ser Gly Gly Asn Gln Gln Lys Ala Ile Ile Ala Arg
405 410 415

Glu Ile Asp Arg Asp Pro Asp Leu Leu Ile Val Ser Gln Pro Thr Arg
420 425 430

Gly Leu Asp Val Gly Ala Ile Glu Tyr Ile His Lys Arg Leu Ile Glu
435 440 445

Glu Arg Asp Asn Gly Lys Ala Val Leu Val Val Ser Phe Glu Leu Asp
450 455 460

Glu Ile Leu Asn Val Ser Asp Arg Ile Ala Val Ile His Asp Gly Lys
465 470 475 480

Ile Gln Gly Ile Val Ser Pro Glu Thr Thr Asn Lys Gln Glu Leu Gly
485 490 495

Val Leu Met Ala Gly Gly Asn Leu Gly Lys Glu Lys Ser Asp Val
500 505 510

<210> 290
<211> 307
<212> PRT
<213> Streptococcus pneumoniae

<400> 290

Met Thr Glu Leu Ala Lys Gln Leu Leu Glu Leu Thr Tyr Ile Val Ile
1 5 10 15

Gly Cys Gln Phe Leu His Thr Ala Tyr Cys Ser Tyr Lys Asp Lys Thr
20 25 30

Asn Pro Val Arg Leu Gly Thr Ser Ala Phe Trp Thr Leu Leu Ser Ile
35 40 45

Thr Phe Ile Gly Gly Ser Tyr Met Pro Asn Met Ser Ile Gly Ile Ile
50 55 60

```
Val Ile Leu Leu Ser Leu Leu Thr Leu Phe Lys Gln Val Arg Ile Gly
65                  70                  75                  80

Thr Leu Pro Ser Leu Asp Glu Met Lys Ala Asn Ile Glu Ser Asn Arg
                85                  90                  95

Leu Lys Asn Lys Ile Phe Ile Pro Val Met Leu Met Ala Ile Leu Ala
            100                 105                 110

Leu Val Leu Ala Gln Met Ile Pro Glu Phe Ser Lys Ile Ser Ile Ser
        115                 120                 125

Leu Ala Ala Leu Phe Ala Thr Ile Ser Val Leu Val Ile Thr Asn Ser
    130                 135                 140

His Pro Lys Ser Leu Leu Ser Glu Asn Asn Arg Met Thr Gln Gln Val
145                 150                 155                 160

Ser Thr Ser Gly Ile Val Pro Gln Leu Leu Gly Ala Leu Gly Ala Ile
                165                 170                 175

Phe Thr Val Ala Gly Val Gly Asp Val Ile Ser His Leu Ile Ser Gly
            180                 185                 190

Ile Val Pro Ser Asp Ser Arg Phe Ile Gly Val Leu Ala Tyr Val Leu
        195                 200                 205

Gly Met Val Leu Phe Thr Met Ile Met Gly Asn Ala Phe Ala Ala Phe
    210                 215                 220

Thr Val Ile Thr Ala Gly Val Gly Val Pro Phe Val Phe Ala Leu Gly
225                 230                 235                 240

Ala Asn Pro Ile Val Ala Gly Ala Leu Ala Met Thr Ala Gly Tyr Cys
                245                 250                 255

Gly Thr Leu Leu Thr Pro Met Ala Ala Asn Phe Asn Ala Leu Pro Ala
            260                 265                 270

Ala Leu Met Asp Met Lys Asp Gln Asn Gly Val Ile Lys Ala Gln Ala
        275                 280                 285
```

Gly Val Ala Leu Val Met Ile Val Ile His Ile Phe Leu Met Tyr Phe
290 295 300

Leu Ala Phe
305

<210> 291
<211> 369
<212> PRT
<213> Streptococcus pneumoniae

<400> 291

Met Phe Arg Arg Asn Lys Leu Phe Phe Trp Thr Thr Glu Ile Leu Leu
1 5 10 15

Leu Thr Ile Ile Phe Tyr Leu Trp Arg Gln Met Gly Ser Leu Ile Asn
20 25 30

Pro Phe Val Ser Val Leu Asn Thr Ile Met Ile Pro Phe Leu Leu Gly
35 40 45

Gly Phe Phe Tyr Tyr Leu Thr Asn Pro Ile Val Thr Phe Leu Asn Lys
50 55 60

Val Cys Lys Leu Asn Arg Leu Leu Gly Ile Leu Ile Thr Leu Cys Thr
65 70 75 80

Leu Val Trp Gly Met Val Ile Gly Val Val Tyr Leu Leu Pro Ile Leu
85 90 95

Ile Asn Gln Leu Ser Ser Leu Ile Ile Ser Ser Gln Thr Ile Tyr Ser
100 105 110

Arg Val Gln Asp Leu Ile Ile Asp Leu Ser Asn Tyr Pro Ala Leu Gln
115 120 125

Asn Leu Asp Val Glu Ala Thr Ile Gln Gln Leu Asn Leu Ser Tyr Val
130 135 140

Asp Ile Leu Gln Asn Ile Leu Asn Ser Val Ser Asn Ser Val Gly Ser
145 150 155 160

Val Leu Ser Ala Leu Ile Ser Thr Val Leu Ile Leu Ile Met Thr Pro
165 170 175

Val Phe Leu Val Tyr Phe Leu Leu Asp Gly His Lys Phe Leu Pro Met
180 185 190

Leu Glu Arg Thr Ile Leu Lys Arg Asp Arg Leu His Ile Ala Gly Leu
195 200 205

Leu Lys Asn Leu Asn Ala Thr Ile Ala Arg Tyr Ile Ser Gly Val Ser
210 215 220

Ile Asp Ala Ile Ile Ile Gly Cys Leu Ala Tyr Ile Gly Tyr Ser Ile
225 230 235 240

Ile Gly Leu Lys Tyr Ala Leu Val Phe Ala Ile Phe Ser Gly Val Ala
245 250 255

Asn Leu Ile Pro Tyr Val Gly Pro Ser Ile Gly Leu Ile Pro Met Ile
260 265 270

Ile Ala Asn Ile Phe Thr Asp Pro His Arg Leu Leu Ile Ala Val Ile
275 280 285

Tyr Met Leu Val Val Gln Gln Val Asp Gly Asn Ile Leu Tyr Pro Arg
290 295 300

Ile Val Gly Ser Val Met Lys Val His Pro Ile Thr Ile Leu Val Leu
305 310 315 320

Leu Leu Leu Ser Ser Asn Ile Tyr Gly Val Val Gly Met Ile Val Ala
325 330 335

Val Pro Thr Tyr Ser Ile Leu Lys Glu Ile Ser Lys Phe Leu Ser His
340 345 350

Leu Tyr Glu Asn His Lys Ile Met Lys Glu Arg Glu Arg Glu Leu Ala
355 360 365

Lys

<210> 292
<211> 662
<212> PRT
<213> Streptococcus pneumoniae

<400> 292

Met Phe Arg Leu Thr Asn Lys Leu Ala Val Ser Asn Leu Ile Lys Asn
1 5 10 15

Arg Lys Leu Tyr Tyr Pro Phe Ala Leu Ala Val Leu Leu Ala Val Thr
20 25 30

Ile Thr Tyr Leu Phe Tyr Ser Leu Thr Phe Asn Pro Lys Ile Ala Glu
35 40 45

Ile Arg Gly Gly Thr Thr Ile Gln Ala Thr Leu Gly Phe Gly Met Phe
50 55 60

Val Val Thr Leu Ala Ser Ala Ile Ile Val Leu Tyr Ala Asn Ser Phe
65 70 75 80

Val Met Lys Asn Arg Ser Lys Glu Leu Gly Ile Tyr Gly Met Leu Gly
85 90 95

Leu Glu Lys Arg His Leu Ile Ser Met Thr Phe Lys Glu Leu Val Val
100 105 110

Phe Gly Ile Leu Thr Val Gly Ala Gly Ile Gly Ile Gly Ala Leu Phe
115 120 125

Asp Lys Leu Ile Phe Ala Phe Leu Leu Lys Leu Met Lys Leu Lys Val
130 135 140

Glu Leu Val Ala Thr Phe Gln Met Asn Val Val Ile Ala Val Leu Val
145 150 155 160

Val Phe Gly Leu Ile Phe Leu Gly Leu Met Phe Leu Asn Ala Leu Arg
165 170 175

Ile Ala Arg Met Asn Ala Leu Gln Leu Ser Arg Glu Lys Ala Ser Gly

180 185 190

Glu Lys Arg Gly Arg Phe Leu Pro Leu Gln Thr Ile Leu Gly Ser Ile
195 200 205

Ser Leu Gly Ile Gly Tyr Tyr Leu Ala Leu Thr Val Thr Asp Pro Leu
210 215 220

Thr Ala Leu Thr Thr Phe Phe Leu Ala Val Leu Leu Val Ile Phe Gly
225 230 235 240

Thr Tyr Leu Leu Phe Asn Ala Gly Ile Thr Val Phe Leu Gln Ile Leu
245 250 255

Lys Lys Asn Lys Lys Tyr Tyr Tyr Gln Pro Asn Asn Leu Ile Ser Val
260 265 270

Ser Asn Leu Ile Phe Arg Met Lys Lys Asn Ala Val Gly Leu Ala Thr
275 280 285

Ile Ala Ile Leu Ser Thr Met Val Leu Val Thr Met Ser Ala Ala Thr
290 295 300

Ser Ile Phe Asn Ser Ala Glu Ser Phe Lys Lys Val Leu Asn Pro His
305 310 315 320

Asp Phe Gly Val Ser Gly Gln Asn Val Glu Lys Glu Asp Leu Asp Lys
325 330 335

Leu Leu Ser Gln Phe Ala Ser Asp Lys Gly Tyr Ser Val Lys Glu Lys
340 345 350

Glu Val Leu Arg Tyr Ser Asn Phe Gly Ile Ala Asn Gln Glu Gly Thr
355 360 365

Lys Leu Thr Ile Phe Glu Lys Gly Gln Asn Arg Val Gln Pro Thr Thr
370 375 380

Val Phe Met Val Phe Asp Gln Lys Asp Tyr Glu Asn Met Thr Gly Gln
385 390 395 400

Lys Leu Ser Leu Ser Gly Asn Glu Val Gly Leu Phe Ala Lys Asn Asp
405 410 415

Gly Leu Lys Gly Gln Lys Ala Leu Thr Leu Asn Asp His Gln Phe Ser
420 425 430

Val Lys Glu Glu Phe Asn Lys Asp Phe Ile Val Asn His Val Pro Asn
435 440 445

Lys Phe Asn Ile Leu Thr Thr Asp Tyr Asn Tyr Leu Val Val Pro Asp
450 455 460

Leu Gln Ala Phe Leu Asp Gln Phe Pro Asp Ser Ala Ile Tyr Asn Gln
465 470 475 480

Phe Tyr Gly Gly Met Asn Val Asn Val Ser Glu Glu Glu Gln Leu Lys
485 490 495

Val Ala Glu Glu Tyr Glu Asn Tyr Leu Asn Gln Phe Asn Ala Gln Leu
500 505 510

Asp Thr Glu Gly Ser Tyr Val Tyr Gly Ser Asn Leu Ala Asp Ala Ser
515 520 525

Ser Gln Met Ser Ala Leu Phe Gly Gly Val Phe Phe Ile Gly Ile Phe
530 535 540

Leu Ser Ile Ile Phe Met Val Gly Thr Val Leu Val Ile Tyr Tyr Lys
545 550 555 560

Gln Ile Ser Glu Gly Tyr Glu Asp Arg Glu Arg Phe Ile Ile Leu Gln
565 570 575

Lys Val Gly Leu Asp Gln Lys Gln Ile Lys Gln Thr Ile Asn Lys Gln
580 585 590

Val Leu Thr Val Phe Phe Leu Pro Leu Leu Phe Ala Phe Ile His Leu
595 600 605

Ala Phe Ala Tyr His Met Leu Ser Leu Ile Leu Lys Val Ile Gly Val
610 615 620

Leu Asp Thr Thr Met Met Leu Ile Val Thr Leu Ser Ile Cys Ala Ile
625 630 635 640

Phe Leu Ile Ala Tyr Val Leu Ile Phe Met Ile Thr Ser Arg Ser Tyr
645 650 655

Arg Lys Ile Val Gln Met
660

<210> 293
<211> 419
<212> PRT
<213> Streptococcus pneumoniae

<400> 293

Met Ser Arg Leu Leu Val Ile Gly Cys Gly Gly Val Ala Gln Val Ala
1 5 10 15

Ile Ser Lys Ile Cys Gln Asp Ser Glu Thr Phe Thr Glu Ile Met Ile
20 25 30

Ala Ser Arg Thr Lys Ser Lys Cys Asp Asp Leu Lys Ala Lys Leu Glu
35 40 45

Gly Lys Thr Ser Thr Lys Ile Glu Thr Ala Ala Leu Asp Ala Asp Lys
50 55 60

Val Glu Glu Val Ile Ala Leu Ile Glu Ser Tyr Lys Pro Glu Ala Val
65 70 75 80

Leu Asn Val Ala Leu Pro Tyr Gln Asp Leu Thr Ile Met Asp Ala Cys
85 90 95

Leu Ala Thr Gly Val His Tyr Ile Asp Thr Ala Asn Tyr Glu Ala Glu
100 105 110

Asp Thr Glu Asp Pro Glu Trp Arg Ala Ile Tyr Glu Lys Arg Cys Lys
115 120 125

Glu Leu Gly Phe Thr Ala Tyr Phe Asp Tyr Ser Trp Gln Trp Ala Tyr
130 135 140

```
Gln Glu Lys Phe Lys Glu Ala Gly Leu Thr Ala Leu Leu Gly Ser Gly
145                 150                 155                 160

Phe Asp Pro Gly Val Thr Ser Val Phe Ser Ala Tyr Ala Leu Lys His
                165                 170                 175

Tyr Phe Asp Glu Ile His Tyr Ile Asp Ile Leu Asp Cys Asn Gly Gly
            180                 185                 190

Asp His Gly Tyr Pro Phe Ala Thr Asn Phe Asn Pro Glu Ile Asn Leu
        195                 200                 205

Arg Glu Val Ser Ala Pro Gly Ser Tyr Trp Glu Asp Gly Lys Trp Val
    210                 215                 220

Glu Val Glu Ala Met Ser Ile Lys Arg Glu Tyr Asp Phe Pro Gln Val
225                 230                 235                 240

Gly Gln Lys Asp Met Tyr Leu Leu His His Glu Glu Ile Glu Ser Leu
                245                 250                 255

Ala Lys Asn Ile Pro Gly Val Lys Arg Ile Arg Phe Phe Met Thr Phe
            260                 265                 270

Gly Gln Ser Tyr Leu Thr His Met Lys Cys Leu Glu Asn Val Gly Leu
        275                 280                 285

Leu Arg Thr Asp Thr Ile Asn Phe Asn Gly Gln Glu Ile Val Pro Ile
    290                 295                 300

Gln Phe Leu Lys Ala Leu Leu Pro Asp Pro Ala Ser Leu Gly Pro Arg
305                 310                 315                 320

Thr Val Gly Lys Thr Asn Ile Gly Cys Ile Phe Thr Gly Val Lys Asp
                325                 330                 335

Gly Val Lys Lys Thr Ile Tyr Ile Tyr Asn Val Cys Asp His Gln Glu
            340                 345                 350

Cys Tyr Ala Glu Val Gly Ser Gln Ala Ile Ser Tyr Thr Thr Gly Val
        355                 360                 365
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Pro Ala Met Ile Gly Thr Lys Leu Val Met Asn Gly Thr Trp Lys Gln
    370   375   380

Ala Gly Val Tyr Asn Leu Glu Glu Leu Asp Pro Asp Pro Phe Met Glu
385   390   395   400

Ala Leu Asn Glu Tyr Gly Leu Pro Trp Val Val Val Glu Asn Pro Gln
                405   410   415

Met Val Asp

<210> 294
<211> 216
<212> PRT
<213> Streptococcus pneumoniae

<400> 294

Met Glu Ala Ile Ile Glu Lys Ile Lys Glu Tyr Lys Ile Ile Val Ile
1   5   10   15

Cys Thr Gly Leu Gly Leu Leu Val Gly Gly Phe Phe Leu Leu Lys Pro
            20   25   30

Ala Pro Gln Thr Pro Val Lys Glu Thr Asn Leu Gln Ala Glu Val Ala
        35   40   45

Ala Val Ser Lys Asp Ser Ser Thr Glu Lys Glu Val Lys Lys Glu Glu
    50   55   60

Lys Glu Glu Pro Leu Glu Gln Asp Leu Ile Thr Val Asp Val Lys Gly
65   70   75   80

Ala Val Lys Ser Pro Gly Ile Tyr Asp Leu Pro Val Gly Ser Arg Val
                85   90   95

Asn Asp Ala Val Gln Lys Ala Gly Gly Leu Thr Glu Gln Ala Asp Ser
            100   105   110

Lys Ser Leu Asn Leu Ala Gln Lys Val Ser Asp Glu Ala Leu Val Tyr
        115   120   125

Val Pro Thr Lys Gly Glu Glu Ala Val Ser Gln Gln Thr Gly Ser Gly
130 135 140

Thr Ala Ser Ser Thr Ser Lys Glu Lys Lys Val Asn Leu Asn Lys Ala
145 150 155 160

Ser Leu Glu Glu Leu Lys Gln Val Lys Gly Leu Gly Gly Lys Arg Ala
165 170 175

Gln Asp Ile Ile Asp His Arg Glu Ala Asn Gly Lys Phe Lys Ser Val
180 185 190

Asp Glu Leu Lys Lys Val Ser Gly Ile Gly Gly Lys Thr Ile Glu Lys
195 200 205

Leu Lys Asp Tyr Val Thr Val Asp
210 215

<210> 295
<211> 502
<212> PRT
<213> Streptococcus pneumoniae

<400> 295

Met Leu Gln Trp Ile Lys Asn Phe Ser Ile Pro Leu Ile Tyr Leu Ser
1 5 10 15

Phe Leu Leu Leu Trp Leu Tyr Tyr Ala Ile Phe Ser Ala Ser Tyr Leu
20 25 30

Ala Leu Leu Gly Phe Val Phe Leu Leu Val Cys Leu Phe Ile Gln Phe
35 40 45

Pro Trp Lys Ser Ala Gly Lys Val Leu Ile Ile Cys Gly Ile Phe Gly
50 55 60

Phe Trp Phe Val Phe Gln Asn Trp Gln Gln Ser Gln Ala Ser Gln Asn
65 70 75 80

Leu Ala Asp Ser Val Glu Arg Val Arg Ile Leu Pro Asp Thr Ile Lys
85 90 95

Val Asn Gly Asp Ser Leu Ser Phe Arg Gly Lys Ser Asn Gly Arg Ala
100 105 110

Phe Gln Val Tyr Tyr Lys Leu Gln Ser Glu Glu Glu Lys Glu Ala Phe
115 120 125

Gln Ala Leu Thr Asp Leu His Glu Ile Gly Leu Glu Gly Lys Leu Ser
130 135 140

Glu Pro Glu Gly Gln Arg Asn Phe Gly Gly Phe Asn Tyr Gln Ala Tyr
145 150 155 160

Leu Lys Thr Gln Gly Ile Tyr Gln Thr Leu Asn Ile Lys Thr Ile Gln
165 170 175

Ser Leu Gln Lys Ile Gly Ser Trp Asp Ile Gly Glu Asn Leu Ser Ser
180 185 190

Leu Arg Arg Lys Ala Val Val Trp Ile Lys Thr His Phe Pro Asp Pro
195 200 205

Met Gly Asn Tyr Met Thr Gly Leu Leu Leu Gly His Leu Asp Thr Asp
210 215 220

Phe Glu Glu Met Asn Glu Leu Tyr Ser Ser Leu Gly Ile Ile His Leu
225 230 235 240

Phe Ala Leu Ser Gly Met Gln Val Gly Phe Phe Met Asn Gly Phe Lys
245 250 255

Lys Leu Leu Leu Arg Leu Gly Leu Thr Gln Glu Lys Leu Lys Trp Leu
260 265 270

Thr Tyr Pro Phe Ser Leu Ile Tyr Ala Gly Leu Thr Gly Phe Ser Ala
275 280 285

Ser Val Ile Arg Ser Leu Leu Gln Lys Leu Leu Ala Gln His Gly Val
290 295 300

Lys Gly Leu Asp Asn Phe Ala Leu Thr Val Leu Val Leu Phe Ile Val

305 310 315 320

Met Pro Asn Phe Phe Leu Thr Ala Gly Gly Val Leu Ser Cys Ala Tyr
325 330 335

Ala Phe Ile Leu Thr Met Thr Ser Lys Glu Gly Glu Gly Leu Lys Ala
340 345 350

Val Thr Ser Glu Ser Leu Val Ile Ser Leu Gly Ile Leu Pro Ile Leu
355 360 365

Ser Phe Tyr Phe Ala Glu Phe Gln Pro Trp Ser Ile Leu Leu Thr Phe
370 375 380

Val Phe Ser Phe Leu Phe Asp Leu Val Phe Leu Pro Leu Leu Ser Ile
385 390 395 400

Leu Phe Val Leu Ser Phe Leu Tyr Pro Val Ile Gln Leu Asn Phe Ile
405 410 415

Phe Glu Trp Leu Glu Gly Ile Ile Arg Leu Val Ser Gln Val Ala Arg
420 425 430

Arg Pro Leu Val Phe Gly Gln Pro Asn Ala Trp Leu Leu Ile Leu Leu
435 440 445

Leu Ile Ser Leu Ala Leu Val Tyr Asp Leu Arg Lys Asn Ile Lys Gly
450 455 460

Leu Thr Val Leu Ser Leu Leu Ile Thr Gly Leu Phe Phe Leu Thr Lys
465 470 475 480

Tyr Pro Leu Glu Asn Glu Ile Thr Met Leu Asp Val Gly Gln Gly Glu
485 490 495

Ser Ile Phe Tyr Gly Met
500

<210> 296
<211> 77
<212> PRT
<213> Streptococcus pneumoniae

<400> 296

Met Tyr Asn Leu Leu Leu Thr Ile Leu Leu Val Leu Ser Val Val Ile
1 5 10 15

Val Ile Ala Ile Phe Met Gln Pro Thr Lys Asn Gln Ser Ser Asn Val
20 25 30

Phe Asp Ala Ser Ser Gly Asp Leu Phe Glu Arg Ser Lys Ala Arg Gly
35 40 45

Phe Glu Ala Val Met Gln Arg Leu Thr Gly Ile Leu Val Phe Phe Trp
50 55 60

Leu Ala Ile Ala Leu Ala Leu Thr Val Leu Ser Ser Arg
65 70 75

<210> 297
<211> 280
<212> PRT
<213> Streptococcus pneumoniae

<400> 297

Met Leu Ser Trp Leu Ala Arg Val Ile Lys Gly Ile Val Ile Ala Leu
1 5 10 15

Gly Phe Ile Leu Pro Gly Ile Ser Gly Gly Val Leu Ala Ala Ile Leu
20 25 30

Gly Ile Tyr Glu Arg Met Ile Gly Phe Leu Ala His Pro Phe Lys Asp
35 40 45

Phe Lys Glu Asn Val Leu Tyr Phe Ile Pro Val Ala Ile Gly Met Leu
50 55 60

Leu Gly Ile Gly Leu Phe Ser Tyr Pro Ile Glu Tyr Leu Leu Glu Asn
65 70 75 80

Tyr Gln Val Phe Val Leu Trp Ser Phe Ala Gly Ala Ile Ile Gly Thr
85 90 95

Val Pro Ser Leu Leu Lys Glu Ser Thr Arg Glu Ser Asp Arg Asp Lys

100 105 110

Ile Asp Leu Ala Trp Leu Trp Thr Thr Phe Ile Ile Ser Gly Leu Gly
115 120 125

Leu Tyr Ala Leu Asn Phe Val Val Gly Thr Leu Ser Ala Ser Phe Leu
130 135 140

Asn Phe Val Leu Ala Gly Ala Leu Leu Ala Leu Gly Val Leu Val Pro
145 150 155 160

Gly Leu Ser Pro Ser Asn Leu Leu Leu Ile Leu Gly Leu Tyr Ala Pro
165 170 175

Met Leu Thr Gly Phe Lys Thr Phe Asp Phe Leu Gly Thr Phe Phe Pro
180 185 190

Ile Gly Ile Gly Ala Gly Ala Thr Leu Ile Val Phe Ser Lys Leu Ile
195 200 205

Asp Tyr Ala Leu Asn Asn Tyr His Ser Arg Val Tyr His Phe Ile Ile
210 215 220

Gly Ile Val Leu Ser Ser Thr Leu Leu Ile Leu Ile Pro Asn Ala Gly
225 230 235 240

Asn Ala Glu Ser Ile Gln Tyr Thr Gly Leu Ser Leu Val Gly Tyr Val
245 250 255

Ile Ile Ala Phe Phe Phe Ala Leu Gly Ile Trp Leu Gly Ile Trp Met
260 265 270

Ser Gln Leu Glu Asp Lys Tyr Lys
275 280

<210> 298
<211> 210
<212> PRT
<213> Streptococcus pneumoniae

<400> 298

Met Phe Tyr Leu Ser Leu Ser Arg Ile Ala Leu Ser Ser Ser Thr Ser

1 5 10 15

Leu Val Ser Val Ser Ala Glu Pro Phe Ser Ser Phe Thr Lys Ser Arg
20 25 30

Val Ser Trp Arg Arg Phe Trp Ala Leu Ala Arg Thr Phe Leu Ser Ala
35 40 45

Phe Ser Ala Ser Ser Cys Pro Arg Thr Leu Ile Asn Ser Val Leu Asn
50 55 60

Cys Trp Ile Ser Asp Ser Phe Leu Arg Arg Ile Ser Gln Lys Ala Ile
65 70 75 80

Thr Pro Arg Arg Ala Ser Arg Leu Thr Thr Ile Thr Pro Ala Gly Thr
85 90 95

Glu Phe Val Ser Val Ile Leu Ser Glu Ser Leu Leu Ser Ser Val Pro
100 105 110

Cys Phe Ala Ser Phe Leu Ser Cys Ala Gly Leu Leu Ser Leu Ala Phe
115 120 125

Ala Phe Thr Ser Leu Arg Glu Ser Lys Ala Ala Gln Pro Ser Gln Thr
130 135 140

Leu Leu Gln Tyr Ala Asp Leu Thr Leu Ser Arg His Tyr Leu Pro Glu
145 150 155 160

Leu Phe Glu His Leu Gly Gly Gln Pro Trp Leu His Arg Phe Ser Asp
165 170 175

Gln Ile Leu Leu Pro Lys Leu Ser Ser Val Gly Leu Thr Leu Asp Ser
180 185 190

Arg His Glu Val Gln Thr Cys Gln Leu Ala Leu Glu Leu Val Cys Ser
195 200 205

Leu Ser
210

<210> 299
<211> 235
<212> PRT
<213> Streptococcus pneumoniae

<400> 299

Met Glu Thr Ile Val Phe Leu Ile Ser Val Phe Leu Ala Gly Val Leu
1   5   10   15

Ser Phe Phe Ser Pro Cys Ile Phe Pro Leu Leu Pro Val Tyr Ala Gly
            20   25   30

Ile Leu Leu Asp Asp Gln Glu Ser Ala Lys Ser Phe Ser Leu Phe Gly
        35   40   45

Arg Lys Val Leu Trp Ser Gly Leu Ile Arg Thr Leu Cys Phe Ile Ala
    50   55   60

Gly Ile Ser Leu Ile Phe Phe Ile Leu Gly Phe Gly Ala Gly Tyr Phe
65   70   75   80

Gly His Ile Leu Tyr Ala Asn Trp Phe Arg Tyr Gly Met Gly Ala Ile
                85   90   95

Ile Ile Ile Leu Gly Leu His Gln Met Glu Ile Phe His Leu Lys Lys
            100   105   110

Leu Glu Val Gln Lys Ser Phe Thr Phe Lys Lys Ser Asp Ser Asn Arg
        115   120   125

Tyr Trp Ser Ala Phe Leu Leu Gly Ile Thr Phe Ser Phe Gly Trp Thr
    130   135   140

Pro Cys Ile Gly Pro Val Leu Ser Ser Val Leu Ala Leu Ala Ala Ser
145   150   155   160

Gly Gly Asn Gly Ala Trp Gln Gly Ala Ile Tyr Thr Leu Ile Tyr Thr
                165   170   175

Leu Gly Met Ala Leu Pro Phe Leu Val Leu Ala Leu Ala Ser Gly Leu
            180   185   190

Val Met Pro Tyr Phe Ser Lys Ile Lys Arg His Met Met Leu Leu Lys
195 200 205

Lys Ile Gly Gly Phe Leu Ile Val Leu Met Gly Ile Leu Leu Leu Leu
210 215 220

Gly Gln Val Asn Val Leu Ala Gly Ile Phe Glu
225 230 235

<210> 300
<211> 311
<212> PRT
<213> Streptococcus pneumoniae

<400> 300

Met Val Lys Glu Leu Phe Met Lys Lys Gln Asn Leu Phe Leu Val Leu
1 5 10 15

Leu Ser Val Phe Leu Leu Cys Leu Gly Ala Cys Gly Gln Lys Glu Ser
20 25 30

Gln Thr Gly Lys Gly Met Lys Ile Val Thr Ser Phe Tyr Pro Ile Tyr
35 40 45

Ala Met Val Lys Glu Val Ser Gly Asp Leu Asn Asp Val Arg Met Ile
50 55 60

Gln Ser Ser Ser Gly Ile His Ser Phe Glu Pro Ser Ala Asn Asp Ile
65 70 75 80

Ala Ala Ile Tyr Asp Ala Asp Val Phe Val Tyr His Ser His Thr Leu
85 90 95

Glu Ser Trp Ala Gly Ser Leu Asp Pro Asn Leu Lys Lys Ser Lys Val
100 105 110

Lys Val Leu Glu Ala Ser Glu Gly Met Thr Leu Glu Arg Val Pro Gly
115 120 125

Leu Glu Asp Val Glu Ala Gly Asp Gly Val Asp Glu Lys Thr Leu Tyr
130 135 140

Asp Pro His Thr Trp Leu Asp Pro Glu Lys Ala Gly Glu Glu Ala Gln
145 150 155 160

Ile Ile Ala Asp Lys Leu Ser Glu Val Asp Ser Glu His Lys Glu Thr
165 170 175

Tyr Gln Lys Asn Ala Gln Ala Phe Ile Lys Lys Ala Gln Glu Leu Thr
180 185 190

Lys Lys Phe Gln Pro Lys Phe Glu Lys Ala Thr Gln Lys Thr Phe Val
195 200 205

Thr Gln His Thr Ala Phe Ser Tyr Leu Ala Lys Arg Phe Gly Leu Asn
210 215 220

Gln Leu Gly Ile Ala Gly Ile Ser Pro Glu Gln Glu Pro Ser Pro Arg
225 230 235 240

Gln Leu Thr Glu Ile Gln Glu Phe Val Lys Thr Tyr Lys Val Lys Thr
245 250 255

Ile Phe Thr Glu Ser Asn Ala Ser Ser Lys Val Ala Glu Thr Leu Val
260 265 270

Lys Ser Thr Gly Val Gly Leu Lys Thr Leu Asn Pro Leu Glu Ser Asp
275 280 285

Pro Gln Asn Asp Lys Thr Tyr Leu Glu Asn Leu Glu Glu Asn Met Ser
290 295 300

Ile Leu Ala Glu Glu Leu Lys
305 310

<210> 301
<211> 125
<212> PRT
<213> Streptococcus pneumoniae

<400> 301

Met Leu Lys Asn Leu Lys Ser Phe Leu Leu Arg Gly Asn Val Ile Asp
1 5 10 15

Leu Ala Val Gly Val Val Ile Ala Ser Ala Phe Gly Ala Ile Val Thr
20 25 30

Ser Leu Val Asn Asp Ile Ile Thr Pro Leu Ile Leu Asn Pro Ala Leu
35 40 45

Lys Ala Ala Lys Val Glu Arg Ile Ala Gln Leu Ser Trp His Gly Val
50 55 60

Gly Tyr Gly Asn Phe Leu Ser Ala Ile Ile Asn Phe Ile Phe Val Gly
65 70 75 80

Thr Ala Leu Phe Phe Ile Ile Lys Gly Ile Glu Lys Ala Gln Lys Leu
85 90 95

Thr Gly Ile Lys Glu Glu Lys Thr Asp Glu Lys Lys Pro Thr Glu Leu
100 105 110

Glu Val Leu Gln Glu Ile Lys Ala Leu Leu Glu Lys Lys
115 120 125

<210> 302
<211> 339
<212> PRT
<213> Streptococcus pneumoniae

<400> 302

Met His Ala Lys Met Arg Asn Lys Lys Gln Ile Asn Leu Gly Ile Ile
1 5 10 15

Phe Ile Ile Cys Leu Gly Leu Leu Ile Thr Ile Phe Leu Ser Leu Lys
20 25 30

Leu Gly Thr Lys Glu Ile Asn Ile Arg Asp Phe Leu Ala Ala Phe Gly
35 40 45

Met Gly Asn Thr Asn Asp Asp Phe Ile Lys Ser Ile Ile Tyr Lys Arg
50 55 60

Ile Pro Arg Thr Ile Phe Ala Ile Leu Ala Gly Ser Ser Leu Ala Ile
65 70 75 80

Ser Gly Val Leu Met Gln Ser Val Thr Arg Asn Pro Ile Ala Asp Pro
85 90 95

Gly Ile Leu Gly Ile Asn Thr Gly Ala Ser Leu Ser Val Val Ile Gly
100 105 110

Leu Ser Phe Leu Gly Ile Ser Ser Ser Ile Ser His Ile Ser Phe Ala
115 120 125

Ile Ile Gly Gly Leu Val Ser Ala Ile Phe Val Tyr Ala Ile Ala Val
130 135 140

Ser Gly Lys Ala Gly Leu Thr Pro Ile Lys Leu Ala Leu Ser Gly Thr
145 150 155 160

Cys Val Ser Met Ala Leu Ser Ser Phe Val Ser Phe Leu Ile Leu Pro
165 170 175

Asn Asn Asn Val Leu Asp Lys Phe Arg Phe Trp Gln Ile Gly Ser Leu
180 185 190

Gly Ala Ala Thr Leu Ser Ser Ile Ser Thr Leu Leu Pro Phe Ile Ile
195 200 205

Leu Gly His Leu Ile Ala Ile Phe Ile Ser Ser Asp Leu Asn Ala Leu
210 215 220

Ala Met Gly Asp Glu Met Ala Val Gly Leu Gly Val Asn Val Asn Arg
225 230 235 240

Ile Arg Ser Leu Ala Ile Ile Ala Ser Val Leu Leu Cys Ser Ser Ile
245 250 255

Thr Ala Ile Gly Gly Pro Ile Gly Phe Val Gly Leu Ile Val Pro His
260 265 270

Phe Cys Gly Leu Phe Ile Ser Lys Asp Ile Arg Thr Met Thr Ile Ser
275 280 285

Ser Ser Phe Ile Gly Ala Glu Leu Leu Leu Ile Cys Asp Ile Ile Gly
290 295 300

Arg Met Leu Gly Lys Pro Gly Glu Ile Glu Val Gly Ile Ile Thr Ala
305 310 315 320

Ile Ile Gly Gly Pro Val Leu Ile Tyr Val Thr Met Lys Asn Arg Gly
325 330 335

Val Asn Asn

<210> 303
<211> 335
<212> PRT
<213> Streptococcus pneumoniae

<400> 303

Met Gln Asn Leu Ile Ile Gly Ile Gln Lys Arg Lys Asn Arg Ile Thr
1 5 10 15

Leu Phe Ser Ser Leu Phe Leu Leu Ile Ile Ile Ser Leu Ser Phe Phe
20 25 30

Ile Leu Leu Ile Gly Asp Glu Ser Tyr Ser Phe Ser Thr Leu Ile Lys
35 40 45

Val Leu Asn Ser Glu Thr Val Pro Gly Ala Ser Phe Ser Ile Met Glu
50 55 60

Ile Arg Leu Pro Lys Leu Leu Ala Gly Ile Ile Ala Gly Trp Ser Phe
65 70 75 80

Gly Leu Ala Gly Phe Ile Phe Gln Thr Met Leu Arg Asn Pro Leu Ala
85 90 95

Ser Pro Asp Ile Ile Gly Val Thr Ser Ser Ser Ser Ile Ala Ala Val
100 105 110

Phe Cys Ile Leu Val Leu Lys Thr Asn Ser Leu Thr Thr Gly Ile Ile
115 120 125

Ser Ile Thr Cys Gly Leu Thr Ser Ser Leu Ile Leu Phe Leu Leu Ala
130 135 140

Lys Lys Asp Gly Phe Ser Ala Ala Arg Leu Ile Ile Leu Gly Ile Gly
145 150 155 160

Phe Gln Ala Val Thr Arg Ala Gly Thr Ser Phe Leu Leu Leu Lys Val
165 170 175

Ala Arg Tyr Glu Leu Gln Glu Val Met Arg Trp Leu Ser Gly Ser Leu
180 185 190

Ser Phe Thr Lys Leu Asp Asp Ile Pro Leu Val Leu Ile Val Ser Ile
195 200 205

Ile Ala Thr Ile Leu Val Leu Phe Phe Asn Lys Arg Leu Glu Ile Ile
210 215 220

Glu Leu Gly Glu Glu Ile Ala Ile Gly Leu Gly Ala Asn Pro Glu Leu
225 230 235 240

Ser Arg Leu Val Leu Ile Phe Cys Ala Val Ser Leu Thr Ala Phe Ser
245 250 255

Thr Ser Ile Thr Gly Pro Ile Ala Cys Ile Ser Phe Leu Ala Gly Pro
260 265 270

Ile Ala Leu Asn Ile Gly Lys Lys Arg Ser Pro Ile Leu Ala Gly Leu
275 280 285

Val Gly Ile Leu Leu Val Leu Leu Ser Asp Ile Phe Ser Gln Asn Ile
290 295 300

Leu Pro Ala Arg Tyr Pro Val Gly Val Val Thr Gly Leu Leu Gly Ser
305 310 315 320

Pro Tyr Leu Ile Tyr Leu Leu Ile Lys Met Asn Arg Arg Asn Ile
325 330 335

<210> 304
<211> 305
<212> PRT
<213> Streptococcus pneumoniae

<400> 304

```
Met Asn Cys Phe Leu Lys Met Asn Asn Val Ser Val Arg Tyr Asp Asp
1               5                   10                  15

Val Ile Ala Leu Lys Asp Ile Thr Leu Gln Ile Asn Lys Gly Asp Phe
            20                  25                  30

Ile Gly Leu Leu Gly Ser Asn Gly Ala Gly Lys Ser Thr Leu Ile Asn
        35                  40                  45

Ser Ile Val Gly Phe Gln Glu Ile Tyr Leu Gly Glu Ile Glu Tyr Cys
    50                  55                  60

Asp Lys Asp Leu Ile Val Ser Ser Gln Pro Phe Ala His Leu Gly Phe
65                  70                  75                  80

Thr Pro Gln Thr Thr Val Ile Asp Phe Tyr Thr Thr Val Lys Asp Asn
                85                  90                  95

Val Ile Leu Gly Leu Asn Leu Ala Gly Lys Phe Gly Lys Asn Ala Glu
            100                 105                 110

Lys Leu Cys Gln Ile Ala Leu Glu Ile Val Gly Leu Ala Asp Lys Lys
        115                 120                 125

Asn Asn Leu Val Glu Thr Leu Ser Gly Gly Gln Leu Gln Arg Val Gln
    130                 135                 140

Ile Ala Arg Ala Ile Ala His Asn Pro Asp Phe Tyr Ile Leu Asp Glu
145                 150                 155                 160

Pro Thr Val Gly Leu Asp Thr Glu Ser Ala Glu Lys Phe Leu Met Tyr
                165                 170                 175

Leu Lys Asp Lys Ser Leu Glu Gly Lys Thr Ile Ile Ile Ser Ser His
            180                 185                 190

Asp Ile Asn Leu Leu Glu Lys Phe Cys Lys Lys Ile Leu Phe Leu Gln
        195                 200                 205

Asn Gly Ser Ile Ser Phe Phe Gly Asp Met Arg Asp Phe Val Asp Asn
    210                 215                 220
```

Ser Thr Ile Lys Leu Asn Phe Ser Met Gln Asn Arg Ile Ser Arg Tyr
225 230 235 240

Gln Ile Glu Phe Leu Glu Asn Phe Arg Phe Lys Val His Ile Glu Asp
245 250 255

Asn Asp Ser Phe Thr Ile Glu Val Pro Ile Glu Glu Lys Ile Leu Asp
260 265 270

Val Ile Asn Glu Val Gly Lys Ala Cys Glu Ile Lys Asn Phe Ser Thr
275 280 285

Ser Lys Leu Thr Leu Gln Glu Ser Tyr Leu Gln Arg Ile Gly Gly Glu
290 295 300

Lys
305

<210> 305
<211> 266
<212> PRT
<213> Streptococcus pneumoniae

<400> 305

Met Lys Ala Asp Gln Leu Arg His Lys Ser Asp Leu Gly Leu Arg Gly
1 5 10 15

Leu Ala Ile Ile Ala Lys Asn Glu Ile Ile Ala Phe Phe Arg Ser Lys
20 25 30

Gly Leu Ile Ile Ser Gln Phe Leu Gln Pro Ile Leu Tyr Val Val Phe
35 40 45

Ile Ile Ile Gly Leu Asn Ser Ser Ile Lys Asn Ile Gln Phe Asn Asp
50 55 60

Ile Lys Thr Ser Tyr Ala Glu Tyr Thr Ile Ile Gly Val Ile Ala Leu
65 70 75 80

Leu Ile Ile Gly Gln Met Thr Gln Val Ile Tyr Arg Val Thr Ile Asp
85 90 95

Lys Lys Tyr Gly Leu Leu Ala Leu Lys Leu Cys Ser Gly Val Arg Pro
100 105 110

Leu Tyr Tyr Ile Leu Gly Met Ser Ile Tyr Ser Ile Leu Gly Leu Ile
115 120 125

Val Gln Glu Ile Ile Ile Tyr Ile Ile Thr Leu Ala Phe Glu Ile Asn
130 135 140

Ile Ala Met Asp Arg Phe Phe Tyr Thr Val Leu Leu Ser Ile Val Val
145 150 155 160

Leu Leu Phe Trp Asp Ser Leu Ala Ile Leu Leu Thr Met Phe Ile Asn
165 170 175

Asp Tyr Arg Arg Arg Asp Ile Val Ile Arg Phe Val Leu Thr Pro Leu
180 185 190

Gly Phe Thr Ala Pro Val Phe Tyr Leu Ile Asp Ser Ala Pro Ser Ile
195 200 205

Val Arg Trp Ile Gly Gln Leu Asn Pro Leu Thr Tyr Gln Leu Thr Ile
210 215 220

Leu Arg Asn Phe Tyr Phe Lys Asn Ser Thr Thr Leu Glu Leu Val Phe
225 230 235 240

Leu Leu Leu Thr Ser Leu Leu Val Leu Ile Ser Val Ser Phe Ile Ile
245 250 255

Pro Lys Ile Lys Leu Ile Leu Ile Glu Arg
260 265

<210> 306
<211> 344
<212> PRT
<213> Streptococcus pneumoniae

<400> 306

Met Leu Lys Glu Ile Lys Arg Arg Asn Arg Met Lys Asn Lys Arg Leu
1 5 10 15

```
Ile Gly Ile Ile Ala Ala Leu Ala Val Leu Val Ala Gly Ser Leu Ile
            20                  25                  30

Tyr Ser Ser Met Asn Lys Ser Glu Ala Gln Asn Asn Lys Asp Glu Lys
        35                  40                  45

Lys Ile Thr Lys Ile Gly Val Leu Gln Phe Val Ser His Pro Ser Leu
    50                  55                  60

Asp Leu Ile Tyr Lys Gly Ile Gln Asp Gly Leu Ala Glu Glu Gly Tyr
65                  70                  75                  80

Lys Asp Asp Gln Val Lys Ile Asp Phe Met Asn Ser Glu Gly Asp Gln
                85                  90                  95

Ser Lys Val Ala Thr Met Ser Lys Gln Leu Val Ala Asn Gly Asn Asp
            100                 105                 110

Leu Val Val Gly Ile Ala Thr Pro Ala Ala Gln Gly Leu Ala Ser Ala
        115                 120                 125

Thr Lys Asp Leu Pro Val Ile Met Ala Ala Ile Thr Asp Pro Ile Gly
    130                 135                 140

Ala Asn Leu Val Lys Asp Leu Lys Lys Pro Gly Gly Asn Val Thr Gly
145                 150                 155                 160

Val Ser Asp His Asn Pro Ala Gln Gln Gln Val Glu Leu Ile Lys Ala
                165                 170                 175

Leu Thr Pro Asn Val Lys Thr Ile Gly Ala Leu Tyr Ser Ser Ser Glu
            180                 185                 190

Asp Asn Ser Lys Thr Gln Val Glu Glu Phe Lys Ala Tyr Ala Glu Lys
        195                 200                 205

Ala Gly Leu Thr Val Glu Thr Phe Ala Val Pro Ser Thr Asn Glu Ile
    210                 215                 220

Ala Ser Thr Val Thr Val Met Thr Ser Lys Val Asp Ala Ile Trp Val
```

225 230 235 240

Pro Ile Asp Asn Thr Ile Ala Ser Gly Phe Pro Thr Val Val Ser Ser
245 250 255

Asn Gln Ser Ser Lys Lys Pro Ile Tyr Pro Ser Ala Thr Ala Met Val
260 265 270

Glu Val Gly Gly Leu Ala Ser Val Val Ile Asp Gln His Asp Leu Gly
275 280 285

Val Ala Thr Gly Lys Met Ile Val Gln Val Leu Lys Gly Ala Lys Pro
290 295 300

Ala Asp Thr Pro Val Asn Val Phe Ser Thr Gly Lys Ser Val Ile Asn
305 310 315 320

Lys Lys Ile Ala Gln Glu Leu Gly Ile Thr Ile Pro Glu Ser Val Leu
325 330 335

Lys Glu Ala Gly Gln Val Ile Glu
340

<210> 307
<211> 252
<212> PRT
<213> Streptococcus pneumoniae

<400> 307

Met Thr Ala Ile Val Glu Leu Lys Asn Ala Thr Lys Ile Val Lys Asn
1 5 10 15

Gly Phe Asp Glu Glu Lys Ile Ile Leu Asn Asp Val Ser Leu Glu Ile
20 25 30

Phe Glu Arg Asp Phe Ile Thr Ile Leu Gly Gly Asn Gly Ala Gly Lys
35 40 45

Ser Thr Leu Phe Asn Thr Ile Ala Gly Thr Leu Ser Leu Thr Ser Gly
50 55 60

Thr Ile Arg Ile Leu Gly Glu Asp Leu Thr Lys Phe Ser Pro Glu Lys

65 70 75 80

Arg Ala Lys Tyr Leu Ser Arg Val Phe Gln Asp Pro Lys Met Gly Thr
85 90 95

Ala Pro Arg Met Thr Val Ala Glu Asn Leu Leu Ile Ala Lys Phe Arg
100 105 110

Gly Glu Lys Arg Gly Leu Leu Pro Arg Arg Leu Thr Ser Tyr Lys Asp
115 120 125

Glu Phe Gln Ala Thr Ile Glu Lys Val Gly Asn Gly Leu Glu Lys His
130 135 140

Leu Asn Thr Pro Ile Glu Phe Leu Ser Gly Gly Gln Arg Gln Ala Leu
145 150 155 160

Ser Leu Leu Met Ala Thr Leu Lys Arg Pro Glu Leu Leu Leu Leu Asp
165 170 175

Glu His Thr Ala Ala Leu Asp Pro Lys Thr Ser Val Ala Leu Met Glu
180 185 190

Leu Thr Asp Glu Phe Val Lys Lys Asp Gln Leu Thr Ala Leu Met Ile
195 200 205

Thr His His Met Glu Asp Ala Leu Lys Tyr Gly Asn Arg Leu Ile Val
210 215 220

Met Lys Glu Gly Arg Ile Ile Gln Asp Leu Asn Gln Glu Glu Lys Ala
225 230 235 240

Lys Met Lys Ile Ser Asp Tyr Tyr Gln Leu Phe Glu
245 250

<210> 308
<211> 234
<212> PRT
<213> Streptococcus pneumoniae

<400> 308

Met Gly Gly Lys Met Arg Leu Leu Pro Ile Arg Lys Ile Ser Arg Gln

1 5 10 15

Ser Lys Arg Leu Ala Leu Phe Leu Thr Phe Cys Ala Gly Tyr Val Asp
20 25 30

Ala Tyr Thr Phe Ile Val Arg Gly Asn Thr Leu Val Ala Gly Gln Thr
35 40 45

Gly Asn Val Val Phe Leu Ser Val Glu Leu Ile Lys Asn Asn Val Ser
50 55 60

Asp Val Arg Asp Lys Val Leu Thr Leu Leu Ala Phe Met Met Gly Val
65 70 75 80

Phe Leu Leu Thr Ile Tyr Lys Glu Lys Leu Arg Ile Val Lys Lys Pro
85 90 95

Ile Leu Ser Leu Ile Pro Leu Ala Ile Leu Ser Ile Ile Ile Ala Phe
100 105 110

Val Pro Gln Thr Val Asp Asn Ile Tyr Leu Val Pro Pro Leu Ala Phe
115 120 125

Cys Met Gly Leu Val Thr Thr Ala Phe Gly Glu Val Ser Gly Ile Ala
130 135 140

Tyr Asn Asn Ala Phe Met Thr Gly Asn Ile Lys Arg Thr Met Leu Ala
145 150 155 160

Phe Gly Asp Tyr Phe Arg Thr Lys His Thr Pro Phe Leu Arg Glu Gly
165 170 175

Phe Ile Phe Val Ser Leu Leu Ser Ser Phe Val Leu Gly Val Val Phe
180 185 190

Ser Ala Tyr Leu Thr Ile Phe Tyr His Glu Lys Thr Ile Leu Gly Val
195 200 205

Pro Ile Met Met Ser Val Phe Tyr Leu Ser Met Leu Phe Ala Ser Trp
210 215 220

Gln Lys Lys Val Lys Glu Lys Ala Ser Phe
225 230

<210> 309
<211> 282
<212> PRT
<213> Streptococcus pneumoniae

<400> 309

Met Ile Lys Lys Ile Tyr Pro Ile Phe Thr Ile Leu Leu Gly Ala Ala
1 5 10 15

Ile Tyr Ala Phe Gly Leu Thr Tyr Phe Val Val Pro His His Leu Phe
20 25 30

Glu Gly Gly Ala Thr Gly Ile Thr Leu Ile Thr Phe Tyr Leu Phe Lys
35 40 45

Ile Pro Val Ser Leu Met Asn Leu Leu Ile Asn Ile Pro Leu Phe Ile
50 55 60

Leu Ala Trp Lys Ile Phe Gly Ala Lys Ser Leu Tyr Ser Ser Leu Leu
65 70 75 80

Gly Thr Leu Ala Leu Ser Gly Trp Leu Ala Phe Phe Glu His Ile Pro
85 90 95

Leu His Ile Asp Leu Gln Gly Asp Leu Leu Ile Thr Ala Leu Ile Ala
100 105 110

Gly Ile Leu Leu Gly Ile Gly Leu Gly Ile Ile Phe Asn Ala Gly Gly
115 120 125

Thr Thr Gly Gly Thr Asp Ile Leu Ala Arg Ile Leu Asn Lys Tyr Thr
130 135 140

His Ile Ser Ile Gly Lys Leu Leu Phe Ile Leu Asp Phe Cys Ile Leu
145 150 155 160

Met Leu Ile Leu Leu Ile Phe Lys Asp Leu Arg Leu Val Ser Tyr Thr
165 170 175

Leu Leu Phe Asp Phe Ile Val Ser Arg Val Ile Asp Leu Ile Gly Glu
180 185 190

Gly Gly Tyr Ala Gly Lys Gly Phe Met Ile Ile Thr Lys Arg Pro Asp
195 200 205

Gln Leu Ala Lys Ala Ile Asn Asp Asp Leu Gly Arg Gly Val Thr Phe
210 215 220

Ile Ser Gly Gln Gly Tyr Tyr Ser Lys Glu Asn Leu Lys Ile Ile Tyr
225 230 235 240

Cys Ile Val Gly Arg Asn Glu Ile Val Lys Thr Lys Glu Met Ile His
245 250 255

Arg Ile Asp Pro Gln Ala Phe Ile Thr Ile Thr Glu Ala His Glu Ile
260 265 270

Leu Gly Glu Gly Phe Thr Phe Glu Lys Glu
275 280

<210> 310
<211> 91
<212> PRT
<213> Streptococcus pneumoniae

<400> 310

Met Ala Asn Lys Gln Asp Leu Ile Ala Lys Val Ala Glu Ala Thr Glu
1 5 10 15

Leu Thr Lys Lys Asp Ser Ala Ala Ala Val Glu Ala Val Phe Ala Ala
20 25 30

Val Ala Asp Tyr Leu Ala Ala Gly Glu Lys Val Gln Leu Ile Gly Phe
35 40 45

Gly Asn Phe Glu Val Arg Glu Arg Ala Glu Arg Lys Gly Arg Asn Pro
50 55 60

Gln Thr Gly Lys Glu Met Thr Ile Ala Ala Ser Lys Val Pro Ala Phe
65 70 75 80

Lys Ala Gly Lys Ala Leu Lys Asp Ala Val Lys
85 90

<210> 311
<211> 356
<212> PRT
<213> Streptococcus pneumoniae

<400> 311

Met Lys Arg Glu Ile Leu Leu Glu Arg Ile Asp Lys Leu Lys Gln Leu
1 5 10 15

Met Pro Trp Tyr Val Leu Glu Tyr Tyr Gln Ser Lys Leu Ala Val Pro
20 25 30

Tyr Ser Phe Thr Thr Leu Tyr Glu Tyr Leu Lys Glu Tyr Asp Arg Phe
35 40 45

Phe Ser Trp Val Leu Glu Ser Gly Ile Ser Asn Ala Asp Lys Ile Ser
50 55 60

Asp Ile Pro Leu Ser Val Leu Glu Asn Met Ser Lys Lys Asp Met Glu
65 70 75 80

Ser Phe Ile Leu Tyr Leu Arg Glu Arg Pro Leu Leu Asn Ala Asn Thr
85 90 95

Thr Lys Gln Gly Val Ser Gln Thr Thr Ile Asn Arg Thr Leu Ser Ala
100 105 110

Leu Ser Ser Leu Tyr Lys Tyr Leu Thr Glu Glu Val Glu Asn Asp Gln
115 120 125

Gly Glu Pro Tyr Phe Tyr Arg Asn Val Met Lys Lys Val Ser Thr Lys
130 135 140

Lys Lys Lys Glu Thr Leu Ala Ala Arg Ala Glu Asn Ile Lys Gln Lys
145 150 155 160

Leu Phe Leu Gly Asp Glu Thr Glu Gly Phe Leu Thr Tyr Ile Asp Gln
165 170 175

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Glu His Pro Gln Gln Leu Ser Asn Arg Ala Leu Ser Ser Phe Asn Lys
            180                 185                 190

Asn Lys Glu Arg Asp Leu Ala Ile Ile Ala Leu Leu Leu Ala Ser Gly
        195                 200                 205

Val Arg Leu Ser Glu Ala Val Asn Leu Asp Leu Arg Asp Leu Asn Leu
    210                 215                 220

Lys Met Met Val Ile Asp Val Thr Arg Lys Gly Cys Lys Arg Asp Ser
225                 230                 235                 240

Val Asn Val Ala Ala Phe Ala Lys Pro Tyr Leu Glu Asn Tyr Leu Ala
                245                 250                 255

Ile Arg Asn Gln Arg Tyr Lys Thr Glu Lys Thr Asp Thr Ala Leu Phe
            260                 265                 270

Leu Thr Leu Tyr Arg Gly Val Pro Asn Arg Ile Asp Ala Ser Ser Val
        275                 280                 285

Glu Lys Met Val Ala Lys Tyr Ser Glu Asp Phe Lys Val Arg Val Thr
    290                 295                 300

Pro His Lys Leu Arg His Thr Leu Ala Thr Arg Leu Tyr Asp Ala Thr
305                 310                 315                 320

Lys Ser Gln Val Leu Val Ser His Gln Leu Gly His Ala Ser Thr Gln
                325                 330                 335

Val Thr Asp Leu Tyr Thr His Ile Val Ser Asp Glu Gln Lys Asn Ala
            340                 345                 350

Leu Asp Ser Leu
        355
```

<210> 312
<211> 118
<212> PRT
<213> Streptococcus pneumoniae

<400> 312

Met Ala Pro Arg Phe Pro Ala Ser Arg Ser Ala Ile Cys Ile Asp Pro
1 5 10 15

Pro Phe Pro Leu Gln Val Pro Val Tyr Leu Pro Arg Ile Ser Ala Ile
20 25 30

Ile Pro Leu Arg Ser Ile Pro Leu Ala Ile Ala Cys Pro Cys Pro Arg
35 40 45

Trp Phe Glu Val Ile Arg Ser Ser Gly Leu Arg Ala Asn Ile Ala Pro
50 55 60

Thr Leu Ala Ala Ser Ser Pro Thr Glu Lys Cys Val Ile Pro Gly Thr
65 70 75 80

Phe Pro Phe Phe Thr Asn Cys Ala Ile Phe Lys Ser Met Arg Arg Ile
85 90 95

Ser Ser Ile Leu Arg Asn Ile Ser Ser Lys Arg Phe Leu Ser Lys Val
100 105 110

Asp Ile Phe Leu Pro Phe
115

<210> 313
<211> 563
<212> PRT
<213> Streptococcus pneumoniae

<400> 313

Met Asn Lys Leu Ile Ala Phe Ile Glu Lys Gly Lys Pro Phe Phe Glu
1 5 10 15

Lys Leu Ser Arg Asn Ile Tyr Leu Arg Ala Ile Arg Asp Gly Phe Ile
20 25 30

Ala Gly Met Pro Val Ile Leu Phe Ser Ser Ile Phe Ile Leu Ile Ala
35 40 45

Phe Val Pro Asn Ser Trp Gly Phe Lys Trp Ser Asp Glu Val Val Ala
50 55 60

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Phe Leu Met Lys Pro Tyr Ser Tyr Ser Met Gly Ile Leu Ala Leu Leu
65                  70                  75                  80

Val Ala Gly Thr Thr Ala Lys Ser Leu Thr Asp Ser Val Asn Arg Ser
                85                  90                  95

Met Glu Lys Thr Asn Gln Ile Lys Tyr Met Ser Thr Leu Leu Ala Ala
            100                 105                 110

Ile Val Gly Leu Leu Met Leu Ala Ala Asp Pro Ile Glu Ser Gly Leu
        115                 120                 125

Ala Thr Gly Phe Leu Gly Thr Lys Gly Leu Leu Ser Ala Phe Leu Ala
    130                 135                 140

Ala Phe Val Thr Val Ala Ile Tyr Lys Val Cys Val Lys Asn Asn Val
145                 150                 155                 160

Thr Ile Arg Met Pro Asp Glu Val Pro Pro Asn Ile Ser Gln Val Phe
                165                 170                 175

Lys Asp Val Ile Pro Phe Thr Leu Ser Val Val Ser Leu Tyr Ala Leu
            180                 185                 190

Asp Leu Leu Ala Arg Tyr Phe Val Gly Ser Ser Val Ala Glu Ser Ile
        195                 200                 205

Gly Lys Phe Phe Ala Pro Leu Phe Ser Ala Ala Asp Gly Tyr Leu Gly
    210                 215                 220

Ile Thr Ile Ile Phe Gly Ala Phe Ala Phe Phe Trp Phe Val Gly Ile
225                 230                 235                 240

His Gly Pro Ser Ile Val Glu Pro Ala Ile Ala Ala Ile Thr Tyr Ala
                245                 250                 255

Asn Ala Glu Val Asn Leu Asn Leu Leu Gln Gln Gly Met His Ala Asp
            260                 265                 270

Lys Ile Leu Thr Ser Gly Thr Gln Met Phe Ile Val Thr Met Gly Gly
        275                 280                 285
```

Thr Gly Ala Thr Leu Val Val Pro Phe Met Phe Met Trp Leu Thr Lys
290 295 300

Ser Lys Arg Asn Arg Ala Ile Gly Arg Ala Ser Val Val Pro Thr Phe
305 310 315 320

Phe Gly Val Asn Glu Pro Ile Leu Phe Gly Ala Pro Leu Val Leu Asn
325 330 335

Pro Ile Phe Phe Ile Pro Phe Ile Phe Ala Pro Ile Ala Asn Val Trp
340 345 350

Ile Phe Lys Phe Phe Ile Glu Thr Leu Gly Met Asn Ser Phe Thr Ala
355 360 365

Asn Leu Pro Trp Thr Thr Pro Ala Pro Leu Gly Leu Val Leu Gly Thr
370 375 380

Asn Phe Gln Val Leu Ser Phe Ile Leu Ala Ala Leu Leu Ile Val Val
385 390 395 400

Asp Val Val Ile Tyr Tyr Pro Phe Leu Lys Val Tyr Asp Glu Gln Ile
405 410 415

Leu Glu Glu Glu Arg Ser Gly Lys Ser Asn Asp Glu Leu Lys Glu Lys
420 425 430

Val Ala Ala Asn Phe Asn Thr Ala Lys Ala Asp Ala Ile Leu Glu Lys
435 440 445

Ala Gly Val Asp Ala Ala Gln Asn Thr Ile Thr Glu Glu Thr Asn Val
450 455 460

Leu Val Leu Cys Ala Gly Gly Gly Thr Ser Gly Leu Leu Ala Asn Ala
465 470 475 480

Leu Asn Lys Ala Ala Ala Glu Tyr Asn Val Pro Val Lys Ala Ala Ala
485 490 495

Gly Gly Tyr Gly Ala His Arg Glu Met Leu Pro Glu Phe Asp Leu Val
500 505 510

Ile Leu Ala Pro Gln Val Ala Ser Asn Phe Glu Asp Met Lys Ala Glu
515 520 525

Thr Asp Lys Leu Gly Ile Lys Leu Ala Lys Thr Glu Gly Ala Gln Tyr
530 535 540

Ile Lys Leu Thr Arg Asp Gly Lys Gly Ala Leu Ala Phe Val Gln Ala
545 550 555 560

Gln Phe Asp

<210> 314
<211> 265
<212> PRT
<213> Streptococcus pneumoniae

<400> 314

Met Val Ser Ser Glu Phe Ile Ser Lys Ile Glu Phe Ala Cys Asn Lys
1 5 10 15

Lys Glu Ser Leu Tyr Ser Gln Ser Lys Phe Lys Tyr Ala Ile Arg Ser
20 25 30

Met Phe Ala Gly Ala Phe Leu Thr Phe Ser Thr Ala Ala Gly Ala Val
35 40 45

Gly Ala Asp Leu Ile Asn Lys Ile Ala Pro Gly Ser Gly Arg Phe Leu
50 55 60

Phe Pro Phe Val Phe Ala Trp Gly Leu Ala Tyr Ile Val Phe Leu Asn
65 70 75 80

Ala Glu Leu Val Thr Ser Asn Met Met Phe Leu Thr Ala Gly Ser Phe
85 90 95

Leu Lys Lys Ile Ser Trp Arg Lys Thr Ala Glu Ile Leu Leu Tyr Cys
100 105 110

Thr Leu Phe Asn Leu Ile Gly Ala Leu Ile Ala Gly Trp Gly Phe Ala
115 120 125

His Ser Ala Ala Tyr Ala Asn Leu Thr His Asp Ser Phe Ile Ser Gly
    130   135   140

Val Val Glu Met Lys Leu Gly Arg Ser Asn Glu Leu Val Leu Leu Glu
145   150   155   160

Ala Ile Leu Ala Asn Ile Phe Val Asn Ile Ala Ile Leu Ser Phe Ile
                165   170   175

Leu Val Lys Asp Gly Gly Ala Lys Leu Trp Leu Val Leu Ser Ala Ile
            180   185   190

Tyr Met Phe Val Phe Leu Thr Asn Glu His Ile Ala Ala Asn Phe Ala
        195   200   205

Ser Phe Ala Ile Val Lys Phe Ser Val Ala Ala Asp Ser Ile Ala Asn
    210   215   220

Phe Gly Val Gly Asn Met Leu Arg His Trp Gly Val Thr Phe Ile Gly
225   230   235   240

Asn Phe Ile Gly Gly Gly Leu Leu Met Gly Leu Pro Tyr Ala Phe Leu
                245   250   255

Asn Lys Asn Glu Asp Thr Tyr Val Asp
            260   265

<210> 315
<211> 449
<212> PRT
<213> Streptococcus pneumoniae

<400> 315

Met Leu Asp Leu Leu Lys Gln Thr Ile Phe Thr Arg Asp Phe Ile Phe
1   5   10   15

Ile Leu Ile Leu Leu Gly Phe Ile Leu Val Val Thr Leu Leu Leu Leu
            20   25   30

Glu Asn Arg Arg Asp Asn Ile Gln Leu Lys Gln Val Asn Gln Lys Val
        35   40   45

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Lys Asp Leu Ile Ala Gly Asp Tyr Ser Lys Val Leu Asp Met Gln Gly
    50                  55                  60

Gly Ser Glu Ile Thr Asn Ile Thr Asn Asn Leu Asn Asp Leu Ser Glu
65                  70                  75                  80

Val Ile Arg Leu Thr Gln Glu Asn Leu Glu Gln Glu Ser Lys Arg Leu
                85                  90                  95

Asn Ser Ile Leu Phe Tyr Met Thr Asp Gly Val Leu Ala Thr Asn Arg
            100                 105                 110

Arg Gly Gln Ile Ile Met Ile Asn Asp Thr Ala Lys Lys Gln Leu Gly
        115                 120                 125

Leu Val Lys Glu Asp Val Leu Asn Arg Ser Ile Leu Glu Leu Leu Lys
    130                 135                 140

Ile Glu Glu Asn Tyr Glu Leu Arg Asp Leu Ile Thr Gln Ser Pro Glu
145                 150                 155                 160

Leu Leu Leu Asp Ser Gln Asp Ile Asn Gly Glu Tyr Leu Asn Leu Arg
                165                 170                 175

Val Arg Phe Ala Leu Ile Arg Arg Glu Ser Gly Phe Ile Ser Gly Leu
            180                 185                 190

Val Ala Val Leu His Asp Thr Thr Glu Gln Glu Lys Glu Glu Arg Glu
        195                 200                 205

Arg Arg Leu Phe Val Ser Asn Val Ser His Glu Leu Arg Thr Pro Leu
    210                 215                 220

Thr Ser Val Lys Ser Tyr Leu Glu Ala Leu Asp Glu Gly Ala Leu Cys
225                 230                 235                 240

Glu Thr Val Ala Pro Asp Phe Ile Lys Val Ser Leu Asp Glu Thr Asn
                245                 250                 255

Arg Met Met Arg Met Val Thr Asp Leu Leu His Leu Ser Arg Ile Asp
```

260 265 270

Asn Ala Thr Ser His Leu Asp Val Glu Leu Ile Asn Phe Thr Ala Phe
275 280 285

Ile Thr Phe Ile Leu Asn Arg Phe Asp Lys Met Lys Gly Gln Glu Lys
290 295 300

Glu Lys Lys Tyr Glu Leu Val Arg Asp Tyr Pro Ile Asn Ser Ile Trp
305 310 315 320

Met Glu Ile Asp Thr Asp Lys Met Thr Gln Val Val Asp Asn Ile Leu
325 330 335

Asn Asn Ala Ile Lys Tyr Ser Pro Asp Gly Gly Lys Ile Thr Val Arg
340 345 350

Met Lys Thr Thr Glu Asp Gln Met Ile Leu Ser Ile Ser Asp His Gly
355 360 365

Leu Gly Ile Pro Lys Gln Asp Leu Pro Arg Ile Phe Asp Arg Phe Tyr
370 375 380

Arg Val Asp Arg Ala Arg Ser Arg Ala Gln Gly Gly Thr Gly Leu Gly
385 390 395 400

Leu Ser Ile Ala Lys Glu Ile Ile Lys Gln His Lys Gly Phe Ile Trp
405 410 415

Ala Lys Ser Glu Tyr Gly Lys Gly Ser Thr Phe Thr Ile Val Leu Pro
420 425 430

Tyr Asp Lys Asp Ala Val Lys Glu Glu Val Trp Glu Asp Glu Val Glu
435 440 445

Asp

<210> 316
<211> 193
<212> PRT
<213> Streptococcus pneumoniae

<400> 316

Met Ser Gly Leu Leu Tyr His Thr Ser Val Tyr Ala Val Lys Lys Glu
1 5 10 15

Ile Leu Val Asn Thr Arg Lys Lys Thr Gln Phe Met Thr Met Thr Ala
20 25 30

Leu Leu Thr Ala Ile Ala Ile Leu Ile Pro Ile Val Met Pro Phe Lys
35 40 45

Ile Val Ile Pro Pro Ala Ser Tyr Thr Leu Gly Ser His Ile Ala Ile
50 55 60

Phe Ile Ala Met Phe Leu Ser Pro Leu Met Ala Val Phe Val Ile Leu
65 70 75 80

Ala Ser Ser Phe Gly Phe Leu Met Ala Gly Tyr Pro Met Val Ile Val
85 90 95

Phe Arg Ala Phe Ser His Ile Ser Phe Gly Ala Leu Gly Ala Leu Tyr
100 105 110

Leu Gln Lys Phe Pro Asp Thr Leu Asp Lys Pro Lys Ser Ser Trp Ile
115 120 125

Phe Asn Phe Val Leu Ala Val Val His Ala Leu Ala Glu Val Leu Ala
130 135 140

Cys Val Val Phe Tyr Ala Thr Ser Gly Thr Asn Val Glu Asn Met Phe
145 150 155 160

Tyr Val Leu Phe Val Leu Val Gly Phe Gly Thr Ile Ile His Ser Met
165 170 175

Val Asp Tyr Thr Leu Ala Leu Ala Val Tyr Lys Val Leu Arg Lys Arg
180 185 190

Arg

<210> 317
<211> 269
<212> PRT
<213> Streptococcus pneumoniae

<400> 317

Met Lys Asn Lys Arg Ile Phe Lys Asp Phe Gln Ala Ser Lys Met Ser
1 5 10 15

Leu Asn Ile Tyr Thr Ser Pro Leu Leu Ala Phe Val Phe Val Phe Ile
20 25 30

Gly Glu Phe Val Ala Phe Thr Leu Tyr Gly Ile Gly Leu Leu Ala Leu
35 40 45

Ile Gly Leu Ala Arg Asn Phe Gly Glu Ala Gly Gln Asn Leu Ala Ser
50 55 60

Tyr Leu Gln Thr Leu His Gln Ser Leu Thr Asp Lys Thr Ser Asp Phe
65 70 75 80

Arg Leu Ile Leu Gly Leu Leu Ala Phe Gly Phe Ile Leu Asn Thr Val
85 90 95

Phe Arg Trp Thr Arg Lys Val Glu Lys Arg Pro Ile Arg Thr Leu Gly
100 105 110

Phe Tyr Arg Glu Asn Phe Leu Ser Asn Leu Leu Lys Gly Phe Ser Leu
115 120 125

Gly Leu Ala Leu Phe Leu Leu Thr Leu Leu Gly Leu Val Val Leu Gly
130 135 140

Gln Tyr Arg Leu Glu Ser Ile His Leu Asn Pro Tyr Ser Leu Ala Phe
145 150 155 160

Val Val Phe Thr Ile Pro Phe Trp Ile Leu Gln Gly Thr Ala Glu Glu
165 170 175

Val Val Ala Arg Ala Trp Leu Leu Pro Gln Leu Ala Ser Arg Thr Asn
180 185 190

Leu Lys Leu Ala Ile Leu Ile Ser Ser Leu Phe Phe Thr Leu Leu His
195 200 205

Met Gly Asn Ser Gly Leu Thr Pro Leu Ser Leu Val Asn Leu Phe Leu
210 215 220

Phe Gly Val Ala Met Ala Leu Tyr Leu Leu Lys Thr Asp Thr Val Trp
225 230 235 240

Gly Val Ala Gly Ile His Gly Ala Trp Asn Phe Ala Gln Gly Asn Leu
245 250 255

Phe Gly Ile Leu Val Ser Gly Gln Pro Ser Glu Arg Leu
260 265

<210> 318
<211> 721
<212> PRT
<213> Streptococcus pneumoniae

<400> 318

Met Lys Lys Lys Phe Leu Ala Phe Leu Leu Ile Leu Phe Pro Ile Phe
1 5 10 15

Ser Leu Gly Ile Ala Lys Ala Glu Thr Ile Lys Ile Val Ser Asp Thr
20 25 30

Ala Tyr Ala Pro Phe Glu Phe Lys Asp Ser Asp Gln Thr Tyr Lys Gly
35 40 45

Ile Asp Val Asp Ile Ile Asn Lys Val Ala Glu Ile Lys Gly Trp Asn
50 55 60

Ile Gln Met Ser Tyr Pro Gly Phe Asp Ala Ala Val Asn Ala Val Gln
65 70 75 80

Ala Gly Gln Ala Asp Ala Ile Met Ala Gly Met Thr Lys Thr Lys Glu
85 90 95

Arg Glu Lys Val Phe Thr Met Ser Asp Thr Tyr Tyr Asp Thr Lys Val
100 105 110

```
Val Ile Ala Thr Thr Lys Ser His Lys Ile Ser Lys Tyr Asp Gln Leu
        115                 120                 125

Thr Gly Lys Thr Val Gly Val Lys Asn Gly Thr Ala Ala Gln Arg Phe
    130                 135                 140

Leu Glu Thr Ile Lys Asp Lys Tyr Gly Phe Thr Ile Lys Thr Phe Asp
145                 150                 155                 160

Thr Gly Asp Leu Met Asn Asn Ser Leu Ser Ala Gly Ala Ile Asp Ala
                165                 170                 175

Met Met Asp Asp Lys Pro Val Ile Glu Tyr Ala Ile Asn Gln Gly Gln
            180                 185                 190

Asp Leu His Ile Glu Met Asp Gly Glu Ala Val Gly Ser Phe Ala Phe
        195                 200                 205

Gly Val Lys Lys Gly Ser Lys Tyr Glu His Leu Val Thr Glu Phe Asn
    210                 215                 220

Gln Ala Leu Ser Glu Met Lys Lys Asp Gly Ser Leu Asp Lys Ile Ile
225                 230                 235                 240

Lys Lys Trp Thr Ala Ser Ser Ser Ser Ala Val Pro Thr Thr Thr Thr
                245                 250                 255

Leu Ala Gly Leu Lys Ala Ile Pro Val Lys Ala Lys Tyr Ile Ile Ala
            260                 265                 270

Ser Asp Ser Ser Phe Ala Pro Phe Val Phe Gln Asn Ser Ser Asn Gln
        275                 280                 285

Tyr Thr Gly Ile Asp Met Glu Leu Ile Lys Ala Ile Ala Lys Asp Gln
    290                 295                 300

Gly Phe Glu Ile Glu Ile Thr Asn Pro Gly Phe Asp Ala Ala Ile Ser
305                 310                 315                 320

Ala Val Gln Ala Gly Gln Ala Asp Gly Ile Ile Ala Gly Met Ser Val
                325                 330                 335
```

Thr Asp Ala Arg Lys Ala Thr Phe Asp Phe Ser Glu Ser Tyr Tyr Thr
            340   345   350

Ala Asn Thr Ile Leu Gly Val Lys Glu Ser Ser Asn Ile Ala Ser Tyr
        355   360   365

Glu Asp Leu Lys Gly Lys Thr Val Gly Val Lys Asn Gly Thr Ala Ser
    370   375   380

Gln Thr Phe Leu Thr Glu Asn Gln Ser Lys Tyr Gly Tyr Lys Ile Lys
385   390   395   400

Thr Phe Ala Asp Gly Ser Ser Met Tyr Asp Ser Leu Asn Thr Gly Ala
                405   410   415

Ile Asp Ala Val Met Asp Asp Glu Pro Val Leu Lys Tyr Ser Ile Ser
            420   425   430

Gln Gly Gln Lys Leu Lys Thr Pro Ile Ser Gly Thr Pro Ile Gly Glu
        435   440   445

Thr Ala Phe Ala Val Lys Lys Gly Ala Asn Pro Glu Leu Ile Glu Met
    450   455   460

Phe Asn Asn Gly Leu Ala Asn Leu Lys Ala Asn Gly Glu Phe Gln Lys
465   470   475   480

Ile Leu Asp Lys Tyr Leu Ala Ser Glu Ser Ser Thr Ala Ser Thr Ser
                485   490   495

Thr Val Asp Glu Thr Thr Leu Trp Gly Leu Leu Gln Asn Asn Tyr Lys
            500   505   510

Gln Leu Leu Ser Gly Leu Gly Ile Thr Leu Ala Leu Ala Leu Ile Ser
        515   520   525

Phe Ala Ile Ala Ile Val Ile Gly Ile Ile Phe Gly Met Phe Ser Val
    530   535   540

Ser Pro Tyr Lys Ser Leu Arg Val Ile Ser Glu Ile Phe Val Asp Val
545   550   555   560

Ile Arg Gly Ile Pro Leu Met Ile Leu Ala Ala Phe Ile Phe Trp Gly
565 570 575

Ile Pro Asn Phe Ile Glu Ser Ile Thr Gly Gln Gln Ser Pro Ile Asn
580 585 590

Asp Phe Val Ala Gly Thr Ile Ala Leu Ser Leu Asn Ala Ala Ala Tyr
595 600 605

Ile Ala Glu Ile Val Arg Gly Gly Ile Gln Ala Val Pro Val Gly Gln
610 615 620

Met Glu Ala Ser Arg Ser Leu Gly Ile Ser Tyr Gly Lys Thr Met Arg
625 630 635 640

Lys Ile Ile Leu Pro Gln Ala Thr Lys Leu Met Leu Pro Asn Phe Val
645 650 655

Asn Gln Phe Val Ile Ala Leu Lys Asp Thr Thr Ile Val Ser Ala Ile
660 665 670

Gly Leu Val Glu Leu Phe Gln Thr Gly Lys Ile Ile Ile Ala Arg Asn
675 680 685

Tyr Gln Ser Phe Lys Met Tyr Ala Ile Leu Ala Ile Phe Tyr Leu Val
690 695 700

Ile Ile Thr Leu Leu Thr Arg Leu Ala Lys Arg Leu Glu Lys Arg Ile
705 710 715 720

Arg

<210> 319
<211> 246
<212> PRT
<213> Streptococcus pneumoniae

<400> 319

Met Ala Lys Leu Lys Ile Asp Val Asn Asp Leu His Lys His Tyr Gly
1 5 10 15

Lys Asn Glu Val Leu Lys Gly Ile Thr Thr Lys Phe Tyr Glu Gly Asp
20 25 30

Val Val Cys Ile Ile Gly Pro Ser Gly Ser Gly Lys Ser Thr Phe Leu
35 40 45

Arg Ser Leu Asn Leu Leu Glu Glu Val Thr Ser Gly His Ile Thr Val
50 55 60

Asn Gly Tyr Asp Leu Thr Glu Lys Thr Thr Asn Val Asp His Val Arg
65 70 75 80

Glu Asn Ile Gly Met Val Phe Gln His Phe Asn Leu Phe Pro His Met
85 90 95

Ser Val Leu Asp Asn Ile Thr Phe Ala Pro Ile Glu His Lys Leu Met
100 105 110

Thr Lys Glu Glu Ala Glu Glu Leu Gly Met Glu Leu Leu Glu Lys Val
115 120 125

Gly Leu Ala Asp Lys Ala Asn Ala Asn Pro Asp Ser Leu Ser Gly Gly
130 135 140

Gln Lys Gln Arg Val Ala Ile Ala Arg Gly Leu Ala Met Asn Pro Asp
145 150 155 160

Ile Met Leu Phe Asp Glu Pro Thr Ser Ala Leu Asp Pro Glu Met Val
165 170 175

Gly Asp Val Leu Asn Val Met Lys Glu Leu Ala Glu Gln Gly Met Thr
180 185 190

Met Ile Ile Val Thr His Glu Met Gly Phe Ala Arg Gln Val Ala Asn
195 200 205

Arg Val Ile Phe Thr Ala Asp Gly Glu Phe Leu Glu Asp Gly Thr Pro
210 215 220

Asp Gln Ile Phe Asp Asn Pro Gln His Pro Arg Leu Lys Glu Phe Leu

225 230 235 240

Asp Lys Val Leu Asn Val
245

<210> 320
<211> 119
<212> PRT
<213> Streptococcus pneumoniae

<400> 320

Met Arg Ile Ile Tyr Leu Ile Ile Gly Phe Leu Ser Leu Thr Leu Ala
1 5 10 15

Ile Val Gly Val Val Leu Pro Leu Leu Pro Thr Thr Pro Phe Leu Leu
20 25 30

Leu Ser Ile Ala Cys Phe Ser Arg Ser Ser Lys Arg Phe Glu Asp Trp
35 40 45

Leu Tyr His Thr Lys Leu Tyr Gln Ala Tyr Val Ala Asp Phe Arg Glu
50 55 60

Thr Lys Ser Ile Ala Arg Glu Arg Lys Lys Lys Ile Ile Val Ser Ile
65 70 75 80

Tyr Val Leu Met Gly Ile Ser Ile Tyr Phe Ala Pro Leu Leu Pro Val
85 90 95

Lys Ile Gly Leu Gly Ala Leu Thr Ile Phe Ile Thr Tyr Tyr Leu Phe
100 105 110

Lys Val Ile Pro Asp Lys Glu
115

<210> 321
<211> 162
<212> PRT
<213> Streptococcus pneumoniae

<400> 321

Met Ser Tyr Leu Arg Phe Phe Phe Ala Phe Phe Ile Leu Leu Ala Ile
1 5 10 15

Arg Phe Met Asp Cys Phe Met Ala Asn Ser Pro Ile Leu Pro Phe Lys
20 25 30

Pro Pro Pro Asn Ile Trp Leu Ile Ser Gly Ile Pro Ala Pro Pro Arg
35 40 45

Ala Asp Lys Ser Gly Ile Pro Pro Cys Pro Ile Ile Pro Ser Arg Ala
50 55 60

Asp Ile Ser Ile Pro Pro Ile Phe Gly Ile Phe Leu Gly Arg Leu Phe
65 70 75 80

Gly Leu Ile Pro Ile Cys Phe Ile Ile Leu Phe Ile Ser Pro Asp Ile
85 90 95

Thr Pro Cys Met Ser Cys Leu Ala Trp Leu Lys Ser Leu Met Asn Leu
100 105 110

Leu Thr Ser Thr Asn Val Phe Pro Glu Pro Ala Ala Ile Arg Arg Arg
115 120 125

Arg Leu Gly Phe Asn Lys Ser Gly Phe Ser Arg Ser Ser Gly Val Ile
130 135 140

Glu Asp Thr Met Ala Arg Leu Arg Ala Ile Trp Arg Ser Ser Thr Phe
145 150 155 160

Met Phe

<210> 322
<211> 124
<212> PRT
<213> Streptococcus pneumoniae

<400> 322

Met Lys Lys Glu Gln Phe Tyr Pro Leu Gly Ile Phe Leu Ala Ala Met
1 5 10 15

Leu Gly Gly Leu Val Arg Tyr Leu Val Ser Thr Trp Leu Pro Ala Ser
20 25 30

Pro Asp Phe Pro Trp Gly Thr Leu Phe Val Asn Tyr Leu Gly Ile Phe
35 40 45

Cys Leu Ile Tyr Leu Val Lys Gly Tyr Leu Val Tyr Lys Gly Thr Ser
50 55 60

Lys Gly Leu Ile Leu Ala Leu Gly Thr Gly Phe Cys Gly Gly Leu Thr
65 70 75 80

Thr Phe Ser Ser Leu Met Leu Asp Thr Val Lys Leu Leu Asp Thr Gly
85 90 95

Arg Tyr Leu Ser Leu Ile Leu Tyr Leu Leu Leu Ser Ile Gly Gly Gly
100 105 110

Leu Leu Leu Ala Tyr Tyr Leu Gly Arg Lys Lys Trp
115 120

<210> 323
<211> 663
<212> PRT
<213> Streptococcus pneumoniae

<400> 323

Met Ala Ile Ser Gln Met Lys Arg Ile Ser Leu Leu Phe Ser Lys Ser
1 5 10 15

Ser Leu Asp Asp Val Leu Lys Thr Ile Gln Glu Leu Glu Ser Val Gln
20 25 30

Phe Arg Asp Leu Lys Val Gln Asp Asn Trp Ser Glu Ala Leu Glu Lys
35 40 45

Asp Glu Val Val Phe Pro Thr Ile Gln Ile Phe His Thr Ser Asn Ser
50 55 60

Asn His Gly Val Ile Glu Gly Asn Asp Ala Leu Thr Tyr Leu Met Asn
65 70 75 80

Gln Gln Gln His Leu Glu Ala Thr Val Glu Lys Leu Gln Glu Tyr Leu
85 90 95

Pro Lys Glu Asn Thr Phe Lys Leu Leu Gln Gln Pro Pro Ile Thr Thr
100 105 110

Ser Tyr Glu Glu Leu Glu Lys Phe Gly Lys Ala Asn Val Ala Glu Gly
115 120 125

Val Leu Lys Lys Val Asn His Gln Ile Asn Arg Val His Glu Leu Glu
130 135 140

Arg His Ile Gln Ser Asn Asn Glu Glu Ile Glu Arg Leu Ile Lys Trp
145 150 155 160

Glu Lys Leu Glu Ile Val Pro Ala Asn Leu Glu Gln Phe Ser Phe Cys
165 170 175

Lys Gly Lys Val Gly Thr Ile Pro Arg Thr Glu Asp Asn Arg Leu Tyr
180 185 190

Asn Ser Leu Leu Glu Asn Asn Ile Glu Val Gln Glu Ile Phe Ser Asn
195 200 205

Asp Arg Glu Tyr Gly Val Val Val Phe Tyr Gln Ser Ser Tyr Ser Ile
210 215 220

Asp Phe Asp Glu Tyr Leu Phe Glu Pro Phe Asp Tyr Ser Arg Lys Glu
225 230 235 240

Leu Pro Lys Gln Arg Val Val Asp Leu Asp Gln Glu Asn Met Gln Leu
245 250 255

Ile Thr Glu Lys Glu Asn Ile Ile Ala Ser Leu Gln Asp Ser Lys Lys
260 265 270

Tyr Leu Ile Asp Leu Gln Trp Gln Ile Asp Tyr Ile Leu Ser Ile Tyr
275 280 285

Ala Arg Gln Ile Ser Lys Asn Asn Phe Leu Cys Thr Pro His Leu Val
290 295 300

Ala Leu Glu Gly Trp Ile Glu Glu Thr Arg Ile Leu Tyr Phe Ile Lys

305 310 315 320

Val Met Asp Glu His Phe Gly His Ser Ile Tyr Ile Tyr Glu Ser Glu
325 330 335

Thr Leu Thr Asp Asn Gln Asp Glu Ile Pro Ile Lys Leu Thr Asn His
340 345 350

Ser Leu Ile Glu Pro Phe Glu Leu Leu Thr Glu Met Tyr Ala Leu Pro
355 360 365

Lys Tyr Tyr Glu Lys Asp Pro Thr Pro Val Leu Ala Pro Phe Tyr Phe
370 375 380

Thr Phe Phe Gly Met Met Val Ala Asp Leu Gly Tyr Gly Leu Leu Leu
385 390 395 400

Phe Leu Gly Thr Met Leu Ala Leu Lys Ile Phe His Leu Pro Ser Ala
405 410 415

Thr Lys Arg Phe Leu Lys Phe Phe Asn Ile Leu Gly Val Ala Val Ala
420 425 430

Ile Trp Gly Gly Ile Tyr Gly Ser Phe Phe Gly Tyr Glu Leu Pro Phe
435 440 445

His Leu Ile Ser Thr Thr Ser Asp Val Met Thr Ile Leu Val Val Ser
450 455 460

Val Val Phe Gly Phe Ile Thr Val Phe Ala Gly Leu Leu Ala Ser Gly
465 470 475 480

Leu Gln Lys Val Arg Met Asn Lys Tyr Ala Glu Ala Tyr Asn Ser Gly
485 490 495

Phe Ala Trp Cys Val Ile Leu Leu Gly Leu Leu Phe Ile Ala Val Gly
500 505 510

Met Leu Met Pro Asp Met Arg Pro Leu Phe Val Leu Gly Lys Trp Val
515 520 525

Ser Ile Phe Asn Ala Val Gly Ile Leu Ile Val Ser Ile Ile Gln Thr
530 535 540

Lys Ser Leu Ser Gly Ile Gly Ala Gly Leu Phe Asn Leu Tyr Asn Ile
545 550 555 560

Ser Ser Tyr Ile Gly Asp Leu Val Ser Phe Thr Arg Leu Met Ala Leu
565 570 575

Gly Leu Ser Gly Ala Ser Ile Ala Ser Ala Phe Asn Leu Ile Val Gly
580 585 590

Leu Phe Pro Gly Ile Leu Ala Lys Leu Thr Ile Gly Leu Val Leu Phe
595 600 605

Ile Leu Leu His Ala Ile Asn Ile Phe Leu Ser Leu Leu Ser Gly Tyr
610 615 620

Val His Gly Ala Arg Leu Ile Phe Val Glu Phe Phe Gly Lys Phe Tyr
625 630 635 640

Glu Gly Gly Gly Lys Pro Phe Gln Pro Leu Lys Ala Ser Glu Lys Tyr
645 650 655

Ile Lys Val Ile Thr Lys Asn
660

<210> 324
<211> 296
<212> PRT
<213> Streptococcus pneumoniae

<400> 324

Met Lys Ile Ile Gly Ile Asp Ile Gly Gly Thr Thr Ile Lys Ala Asp
1 5 10 15

Leu Tyr Asp Glu Phe Gly Thr Ser Leu Asn His Phe Lys Glu Ile Glu
20 25 30

Thr Ile Ile Asp Tyr Asp Leu Gly Thr Asn Gln Ile Leu Asn Gln Val
35 40 45

```
Cys Asp Leu Ile Gly Glu Tyr Thr Leu Asn His Ser Ile Asp Gly Val
    50                  55                  60

Gly Ile Ser Thr Ala Gly Val Val Asn Ala Asn Thr Gly Glu Ile Ile
65                  70                  75                  80

Tyr Ala Gly Tyr Thr Ile Pro Gly Tyr Ile Gly Val Asn Phe Thr Ala
                85                  90                  95

Glu Ile Glu Lys Arg Phe Gly Leu Tyr Thr Phe Val Glu Asn Asp Val
            100                 105                 110

Asn Cys Ala Ala Leu Gly Glu Leu Trp Lys Gly Gln Ala Lys Asp Lys
        115                 120                 125

Lys Asn Val Val Met Val Thr Ile Gly Thr Gly Ile Gly Gly Ser Ile
    130                 135                 140

Ile Val Asn Gly Gln Ile Val Asn Gly Phe Asn Tyr Thr Ala Gly Glu
145                 150                 155                 160

Val Gly Tyr Ile Pro Val Gly Asn Ser Asp Trp Gln Ser Lys Ala Ser
                165                 170                 175

Thr Thr Ala Leu Ile His Leu Tyr Gln Lys Lys Ser Leu Lys Thr Asn
            180                 185                 190

Gln Thr Gly Arg Thr Phe Phe Thr Asp Leu Arg Ser Gly Asp Lys Val
        195                 200                 205

Ala Glu Glu Thr Phe Glu Ile Phe Val Glu Asn Leu Thr Lys Gly Leu
    210                 215                 220

Leu Thr Ile Ser Tyr Leu Leu Asn Pro Glu Ile Leu Ile Leu Gly Gly
225                 230                 235                 240

Gly Ile Leu Asp Ser Lys Asp Ile Leu Leu Pro Glu Ile Gln Ser Ser
                245                 250                 255

Leu Ala Lys Asn Ala Met Asp Asn Arg Phe Leu Pro Lys Asn Leu Val
            260                 265                 270
```

Ala Ala Thr Leu Gly Asn Glu Ala Gly Arg Ile Gly Ala Val Lys Asn
275 280 285

Phe Leu Asp Arg Ile Ser Asn Lys
290 295

<210> 325
<211> 305
<212> PRT
<213> Streptococcus pneumoniae

<400> 325

Met Lys Asp Leu Thr Lys Tyr Lys Gly Val Ile Pro Ala Phe Tyr Ala
1 5 10 15

Cys Tyr Asp Glu Asn Gly Glu Ile Ser Gln Asp Arg Val Lys Ser Leu
20 25 30

Val Gln Tyr Phe Ile Asp Lys Gly Val Lys Gly Ile Tyr Val Asn Gly
35 40 45

Ser Ser Gly Glu Cys Ile Tyr Gln Ser Val Glu Asp Arg Lys Gln Ile
50 55 60

Ile Glu Ala Val Met Glu Val Ala Lys Gly Lys Leu Thr Val Ile Asn
65 70 75 80

His Ile Ala Cys Asn Asn Thr Lys Asp Ser Ile Glu Leu Ala Lys His
85 90 95

Ser Glu Ser Val Gly Val Asp Ala Ile Ala Ala Ile Pro Pro Ile Tyr
100 105 110

Phe Lys Leu Pro Glu Tyr Ser Ile Ala Ala Tyr Trp Asn Ala Met Ser
115 120 125

Glu Ala Ala Ser Asn Thr Asp Phe Ile Ile Tyr Asn Ile Pro Gln Leu
130 135 140

Ala Gly Val Ala Leu Thr Gly Ser Leu Tyr Ala Thr Met Arg Gln Asn
145 150 155 160

Pro Arg Val Ile Gly Val Lys Asn Ser Ser Met Pro Val Gln Asp Ile
165 170 175

Gln Met Phe Val Ala Ala Gly Gly Glu Asp Tyr Ile Val Phe Asn Gly
180 185 190

Pro Asp Glu Gln Tyr Leu Gly Gly Arg Leu Met Gly Ala Glu Ala Gly
195 200 205

Ile Gly Gly Thr Tyr Gly Val Met Pro Asp Leu Phe Leu Lys Leu Glu
210 215 220

Ser Leu Ile Gln Glu Arg Asp Leu Asp Thr Ala Lys Lys Leu Gln Tyr
225 230 235 240

Ala Ile Asn Glu Val Ile Tyr Lys Met Ile Ser Gly Lys Ala Asn Met
245 250 255

Tyr Ala Val Ala Lys Glu Val Leu Arg Leu Asn Glu Lys Leu Asp Leu
260 265 270

Gly Ser Val Arg Gln Pro Leu Glu Ala Leu Ala Glu Gly Asp Leu Glu
275 280 285

Val Ala Lys Gln Ala Ala Glu Leu Ile Gln Gln Ala Arg Lys Glu Phe
290 295 300

Leu
305

<210> 326
<211> 252
<212> PRT
<213> Streptococcus pneumoniae

<400> 326

Met Ile Gly Gly Lys Asn Met Asp Lys Asp Tyr Ile Leu Lys Val Lys
1 5 10 15

Gly Leu Tyr His Gln Phe Leu Leu Gly Asn Asn Lys Thr Leu Gln Val
20 25 30

```
Leu Lys Asn Val Ser Leu Ser Ala Ser Arg Gly Glu Phe Ile Ser Ile
        35                  40                  45

Leu Gly Ile Ser Gly Ser Gly Lys Ser Thr Leu Leu Lys Cys Ile Ser
    50                  55                  60

Ser Leu Leu Glu Pro Thr Ser Gly Glu Val Ile Leu Asn Gly Ile Asn
65                  70                  75                  80

Pro Tyr Lys Ile Arg Asn Ala Lys Leu Ser Ser Ile Arg Arg Asn Glu
                85                  90                  95

Val Ser Phe Ile Phe Gln Ala Tyr Asn Leu Ile Pro Ser Leu Pro Val
            100                 105                 110

Ile Glu Asn Ile Ala Leu Pro Leu Arg Leu Ser Gln Lys Lys Leu Thr
        115                 120                 125

Ile Lys Asn Val Glu Asn Leu Leu Lys Arg Met Lys Phe Asn Ala Gly
    130                 135                 140

Leu Asn Asp Phe Val Gly Thr Leu Ser Gly Gly Glu Gln Gln Lys Val
145                 150                 155                 160

Ala Ile Ala Arg Ala Val Ile Ala Asp Ser Asp Ile Ile Phe Ala Asp
                165                 170                 175

Glu Pro Thr Gly Ala Leu Asp Ser Val Ser Arg Glu Val Ile Phe Glu
            180                 185                 190

Leu Leu Arg Glu Leu Val Gly Ala Gly Lys Cys Val Ile Met Val Thr
        195                 200                 205

His Asp Ile Glu Leu Ala Ser Lys Thr Asp Arg Ala Leu Ile Leu Lys
    210                 215                 220

Asp Gly Lys Ile Phe Lys Glu Leu His Arg Pro Ser Gly Glu Glu Leu
225                 230                 235                 240

Tyr Lys Ile Leu Glu Val Gln Ser Thr Thr Glu Glu
                245                 250
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<210> 327
<211> 535
<212> PRT
<213> Streptococcus pneumoniae

<400> 327

Met Asn Tyr Leu Lys Phe Ile Lys Lys Thr Lys Leu Ile Leu Met Gly
1 5 10 15

Ile Leu Ile Phe Leu Ser Ser Phe Asn Gly Val Leu Leu Ser Gly Ile
20 25 30

Ile Val Tyr Ala Gly Ser Leu Asn Gln Thr Ser Ser Phe Ser Asp Val
35 40 45

Leu Arg Phe Gly Ala Ile Ser Ile Leu Gly Trp Ser Ala Ile Tyr Ile
50 55 60

Ser Asn Tyr Tyr Leu Glu Val Thr Glu Ala Ser Ile Thr Lys Asp Ile
65 70 75 80

Asn Val Lys Ile Lys Gln Gly Tyr Phe Arg Glu Gln Tyr Leu Ser Ser
85 90 95

Glu Met Val Lys Asp Tyr Ser Ser Ile Ile Ser Val Leu Ser Asn Asp
100 105 110

Leu Arg Leu Ile Glu Glu Asn Tyr Phe Arg Gln Ile Phe Glu Ile Ile
115 120 125

Ser Ser Ile Leu Leu Phe Ile Val Ser Leu Ser Phe Met Leu Tyr Leu
130 135 140

Asn Phe Leu Val Ser Ile Ile Phe Ile Val Leu Ser Ala Leu Pro Ile
145 150 155 160

Ile Val Pro Val Phe Met Lys Lys Met Leu Ser Asn Ser Ala Asn Glu
165 170 175

Tyr Ser Asn Ser Asn Ala Glu Tyr Thr His Ile Ile Lys Glu Ile Phe
180 185 190

Asn Gly Phe Lys Thr Leu Lys Ser Tyr Ser Val Thr Lys Glu Ile Ile
195 200 205

Ser Leu Ser Asp Lys Lys Leu Asp Lys Leu Glu Asp Ser Thr Phe Asn
210 215 220

Leu Lys Arg Ser Glu Val Leu Ser Lys Leu Val Ala Val Leu Ile Ser
225 230 235 240

Gly Phe Cys Phe Leu Val Pro Leu Val Val Gly Cys Tyr Phe Val Ile
245 250 255

Tyr His Lys Ser Leu Ser Phe Ser Glu Leu Ile Gly Ile Phe Leu Ala
260 265 270

Asn Asp Lys Val Leu Gly Pro Ile Gln Ser Ile Ala Tyr Ser Leu Asn
275 280 285

Lys Ile Asn Thr Thr Lys Asp Leu Arg Lys Pro Phe Leu Lys Tyr Leu
290 295 300

Ser Gly Glu Lys Asn Phe Ile Asp Ala Glu His Asp Asn Asn Gly Leu
305 310 315 320

Tyr Thr Ser Ser Ile Asp Glu Ile His Met Lys Asp Val Val Tyr Ser
325 330 335

Ile Thr Pro Glu Asn Lys Leu Ser Ile Asp Phe Ser Phe Lys Ser Pro
340 345 350

Phe Arg Val Leu Leu Thr Gly Thr Ser Gly Ser Gly Lys Thr Thr Ile
355 360 365

Leu Asn Leu Ile Asn Gly Ser Leu Lys Pro Gln Lys Gly Tyr Val Asn
370 375 380

Leu Leu Ser His Gly Lys Lys Ser Ser Asp Ser Ile Pro Thr Val Asp
385 390 395 400

Gln Thr Pro Tyr Ile Phe Asp Thr Thr Ile Arg Glu Asn Val Thr Leu

405 410 415

Phe Gln Asn Glu Tyr Phe Ser Asp Asp Gln Ile Ile Glu Val Leu Lys
420 425 430

Lys Val Asn Leu Tyr Glu Glu Leu Glu Lys Ile Asp Ile Leu Asn Tyr
435 440 445

Gln Cys Gly Glu Asn Gly Ser Asn Leu Ser Gly Gly Gln Lys Gln Lys
450 455 460

Ile Ala Leu Ala Arg Ala Leu Ile Arg Asn Asn Lys Val Tyr Leu Phe
465 470 475 480

Asp Glu Ile Ser Ala Asn Leu Asp Asn Asp Asn Ser Asn Ser Ile His
485 490 495

Asp Ile Leu Phe Asn Leu Gly Ile Ser Phe Ile Glu Val Ser His His
500 505 510

Tyr Asp Leu Asn Asp Lys Arg Tyr Thr Asp Ile Tyr Lys Leu Glu Asn
515 520 525

Gly Thr Leu Phe Lys Ile Lys
530 535

<210> 328
<211> 646
<212> PRT
<213> Streptococcus pneumoniae

<400> 328

Met Asn Gln Ser Asn Glu Ile Phe Leu Asn Thr Ile Gln Glu Lys Thr
1 5 10 15

His Tyr Lys Arg Ser Ile Ser Ser Ser Phe Gln Glu Leu Lys Lys Trp
20 25 30

Asn Ser Leu Ile Phe Arg Arg Gly Arg Tyr Trp Tyr Gln Phe Asp Asn
35 40 45

Trp Ser Ile Pro Asn Thr Gly Val Ile Lys Glu Trp Tyr Val Glu Asp

```
            50                  55                  60

Asn Asp Trp Ile Pro Lys Val Ser Ser Ser Ser Leu Asp Asn Ser Asn
65                  70                  75                  80

Ser Leu Lys Ile Val Phe Asp Val Glu Lys Tyr Thr Leu Pro Asp Asp
                85                  90                  95

Ser Ile Leu Gln Asp Val Arg Ile Ser Ser Asp Glu Ser Tyr Ile Val
            100                 105                 110

Leu Val Val Ser Ser Leu Arg Thr Thr Asn Leu Ile Gly Ile Lys Lys
        115                 120                 125

Tyr Thr Met Glu Glu Leu Phe Ile Ile Glu Asp Ile Ser Val Glu Ser
    130                 135                 140

Ser Phe Tyr Leu Gly Lys Phe Gly Val Met Tyr Thr Arg Ser Lys Glu
145                 150                 155                 160

Tyr Gly Arg Pro Ser Lys Leu Phe Tyr Lys Ser Phe Asp Ser Phe Thr
                165                 170                 175

Glu Glu Glu Leu Phe Glu Glu Asn Glu Cys Ser Phe Arg Leu Lys Ile
            180                 185                 190

Val His Ile Asp Ser Asn Asn Cys Phe Val Lys Ser Val Asp Phe Gln
        195                 200                 205

Lys Gly Arg Ile Phe Leu Tyr Ser Phe Asp Arg Thr Gly Phe Val Arg
    210                 215                 220

His Ser Tyr Thr Glu Thr Val Ala Pro Thr Pro Arg Asp Ile Ala Leu
225                 230                 235                 240

Phe Ser Thr Glu Lys Ala Gln Tyr Phe Leu Gly Leu Ser Ser Thr Glu
                245                 250                 255

Glu Lys Lys Asp Gln Leu Ile Leu Arg Glu Thr Ser Ser Gly Asp Arg
            260                 265                 270
```

Val Ser Ile Thr Ile Pro Tyr Gln Asp Arg Ala Arg Arg Val His Cys
275 280 285

Ile Gly Arg Tyr Ile Leu Leu Asp Cys Ser Asn Ala Ala Asn Ser Val
290 295 300

Phe Tyr Leu Ala Thr Phe Lys Asn Asn Ser Leu Arg Glu Leu Ser Val
305 310 315 320

Asn Lys Ile Thr Phe Asp Glu Lys Thr Thr Leu Tyr Glu Asn Ser Phe
325 330 335

Ser Asp Arg Val Leu Leu Phe Leu Glu Arg Arg Thr Phe Tyr Glu Lys
340 345 350

Ile Leu Ser Phe Asp Leu Ile Glu Asn Thr Leu Lys Thr Glu Phe Glu
355 360 365

Arg Pro Ile Ile Lys Ser Asn Asn Thr Lys Tyr Phe Ser Lys Val Ile
370 375 380

Trp Thr Lys Lys Asp Ser Tyr Asp Val Ser Ile Pro Ile Ser Leu Phe
385 390 395 400

Trp Lys Ser Glu Asp Thr Asp Glu Leu Pro Arg Arg Lys Lys Cys Ile
405 410 415

Leu Ser Val Tyr Gly Ala Tyr Gly Lys Asn Asp Asn Ser Asp Leu Asp
420 425 430

Glu Ile Met Leu Ser Ile Ile Asp Ala Gly Phe Ile Tyr Ala Ile Val
435 440 445

His Val Arg Gly Gly Gly Tyr Leu Gly Gly Glu Trp Tyr Arg Ser Gly
450 455 460

Lys Ala Leu Asn Lys Trp Asn Ser Ile Arg Asp Phe Ile Glu Gly Val
465 470 475 480

Asn Tyr Leu Arg Glu Asn Asp Val Ile Asp Ser Lys Arg Leu Gly Leu
485 490 495

Ile Thr Ser Ser Ala Gly Gly Ile Ile Ala Gly Ala Val Leu Asn Glu
500 505 510

Glu Lys Asn Leu Leu Gln Ser Ile Leu Leu Phe Ser Pro Phe Ile Asn
515 520 525

Pro Tyr Asp Thr Leu Gln Asn Pro Asn Asp Pro Leu Ser Lys Thr Glu
530 535 540

Ile Ala Glu Trp Gly Asp Ile Arg Asp Pro Glu Val Lys Ala Tyr Ile
545 550 555 560

Lys Ser Tyr Ser Pro Met Gln Asn Ile Glu Lys Ala Arg Asp Ser Asn
565 570 575

Thr Val Ile Val Asn Ile Leu Gly Glu Lys Asp Pro Tyr Ile Asn Asn
580 585 590

Asn Glu Val Ile Glu Trp Ser Lys Lys Leu Asn Ser Ile Gly Val Lys
595 600 605

Ser Leu Leu Tyr Leu Asn Lys Ala Ala Gly His Gly Gly Phe Thr Pro
610 615 620

Ser Asp Val Leu Leu Met Ile Asp Thr Leu Asn Tyr Phe Phe Glu Glu
625 630 635 640

Val Gly Arg Asn Asn Leu
645

<210> 329
<211> 477
<212> PRT
<213> Streptococcus pneumoniae

<400> 329

Met Ile Asp Gly Lys Arg Leu Leu Phe Ser Leu Thr Ile Val Ser Tyr
1 5 10 15

Ala Leu Thr Leu Val Ser Gly Ile Val Tyr Leu Phe Asn Asn Asn Asn
20 25 30

Val Ser Leu Leu Ser Thr Leu Leu Phe Leu Leu Val Ser Ser Leu Ile
35 40 45

Ala Cys Trp Asn Asp Ile Lys Tyr Tyr Leu Ile His Phe Ile Phe Tyr
50 55 60

Leu Thr Ile Phe Val Phe Leu Val Ser Arg Pro Thr Ile Asp Tyr Phe
65 70 75 80

Arg Asp Gly Ala Leu Asp Thr Tyr His Pro Ile Ala Tyr Arg Phe Ala
85 90 95

Phe Ile Val Val Met Ile Ser Ile Leu Gly Leu Thr Thr Gly Gly Ile
100 105 110

Leu Ala Arg Tyr Phe Ile Ala Arg Lys Lys Ile Lys Val Ala Asn Ile
115 120 125

Gly Asn Ser Leu Lys Glu Val Tyr Ile Lys Arg Leu Arg Phe Val Ser
130 135 140

Leu Gly Val Phe Leu Leu Thr Tyr Pro Phe Tyr Phe Ile Arg Leu Phe
145 150 155 160

Glu Arg Leu Leu Tyr Arg Leu Gln Thr Ser Tyr Tyr Ala Tyr Tyr Ala
165 170 175

Asn Phe Glu Ser Lys Leu Pro Tyr Phe Thr Tyr Ile Leu Ser Thr Phe
180 185 190

Thr Val Tyr Ala Met Cys Met Tyr Leu Ala Thr Lys Pro Lys Lys Leu
195 200 205

Gln Ala Thr Ala Val Leu Val Ser Phe Ile Ala Ala Asn Thr Ile His
210 215 220

Leu Ala Ile Gly Thr Arg Asn Pro Phe Ile Leu Ser Ile Leu Phe Ala
225 230 235 240

Phe Val Tyr Tyr Phe Met Arg Glu Gln Thr Glu Lys Gly Lys Trp Ile
245 250 255

Gly Phe Lys Glu Lys Leu Ala Ile Phe Val Gly Ser Pro Ile Leu Met
260 265 270

Leu Ala Met Gly Val Leu Asn Tyr Val Arg Asp Asn Val Gln Val Ser
275 280 285

His Thr Gly Phe Trp Asp Ile Leu Leu Asp Phe Ile Tyr Lys Gln Gly
290 295 300

Thr Ser Phe Gly Val Leu Ala Arg Gly Phe Leu Phe Asn Ser Ser Leu
305 310 315 320

Pro Tyr Arg Asp Phe Arg Asn Phe Thr Phe Gly Pro Val Leu Asp Tyr
325 330 335

Phe Ala Arg Gly Ser Leu Gly Ala Ile Phe Gly Gly Lys Ala Phe Glu
340 345 350

His Thr Thr Asn Ser Val Glu Leu Ala Ile Asp Ser Asn Ser Tyr Ala
355 360 365

His Asn Leu Ser Tyr Leu Val Leu Asn Lys Glu Tyr Leu Lys Gly His
370 375 380

Gly Ile Gly Ser Ser Tyr Ile Met Glu Leu Tyr Thr Asp Tyr Gly Met
385 390 395 400

Ile Gly Val Phe Leu Leu Ser Phe Leu Leu Gly Val Leu Phe Ile Ala
405 410 415

Met Leu Gln Val Ala Tyr Arg Ser Arg Thr Ile Leu Phe Ala Leu Ser
420 425 430

Leu Leu Ile Leu Asn Asn Leu Phe Phe Met Pro Arg Ser Ser Phe Ser
435 440 445

Glu Ser Phe Phe Asn Leu Phe Thr Met Gln Phe Trp Gly Ile Val Leu
450 455 460

Val Ile Ile Phe Val Ala Lys Met Leu Thr Lys Glu Asn

465 470 475

<210> 330
<211> 275
<212> PRT
<213> Streptococcus pneumoniae

<400> 330

```
Met Gln Ser Arg Arg Lys Glu Met Lys Lys Thr Ser Ser Lys Leu Phe
1               5                   10                  15

Val Val Pro Tyr Met Leu Trp Ile Ala Leu Phe Val Leu Ala Pro Leu
            20                  25                  30

Val Leu Ile Phe Gly Gln Ser Phe Phe Asn Ile Glu Gly Gln Phe Ser
        35                  40                  45

Leu Glu Asn Tyr Lys Ser Tyr Phe Ala Ser Gln Asn Leu Thr Tyr Leu
    50                  55                  60

Lys Met Ser Phe Asn Ser Val Leu Tyr Ala Gly Ile Val Thr Phe Val
65                  70                  75                  80

Ala Leu Leu Ile Ser Tyr Pro Thr Ala Leu Phe Leu Thr Arg Leu Lys
                85                  90                  95

His Arg Gln Leu Trp Leu Met Leu Ile Ile Leu Pro Thr Trp Ile Asn
            100                 105                 110

Leu Leu Leu Lys Ala Tyr Ala Phe Ile Gly Ile Phe Gly Gln Asn Gly
        115                 120                 125

Ser Ile Asn Gln Phe Leu Glu Phe Ile Gly Ile Gly Ser Gln Gln Leu
    130                 135                 140

Leu Phe Thr Asp Phe Ser Phe Ile Phe Val Ala Ser Tyr Ile Glu Leu
145                 150                 155                 160

Pro Phe Met Ile Leu Pro Ile Phe Asn Val Leu Asp Asp Met Asp Asn
                165                 170                 175

Asn Leu Ile Asn Ala Ser Tyr Asp Leu Gly Ala Thr Lys Trp Glu Thr
```

180 185 190

Phe Arg His Val Ile Phe Pro Leu Ser Met Asn Gly Val Arg Ser Gly
195 200 205

Val Gln Ser Val Phe Ile Pro Ser Leu Ser Leu Phe Met Leu Thr Arg
210 215 220

Leu Ile Gly Gly Asn Arg Val Ile Thr Leu Gly Thr Ala Ile Glu Gln
225 230 235 240

Asn Phe Leu Thr Asn Asp Asn Tyr Gly Met Gly Ser Thr Ile Gly Val
245 250 255

Ile Leu Ile Leu Thr Met Phe Ile Thr Met Trp Val Thr Lys Glu Arg
260 265 270

Arg Glu Arg
275

<210> 331
<211> 252
<212> PRT
<213> Streptococcus pneumoniae

<400> 331

Met Thr Asp Ala Ile Leu Gln Val Ser Asp Leu Ser Val Tyr Tyr Asn
1 5 10 15

Lys Lys Lys Ala Leu Asn Ser Val Ser Leu Ser Phe Gln Pro Lys Glu
20 25 30

Ile Thr Ala Leu Ile Gly Pro Ser Gly Ser Gly Lys Ser Thr Leu Leu
35 40 45

Lys Ser Leu Asn Arg Met Gly Asp Leu Asn Pro Glu Val Thr Thr Thr
50 55 60

Gly Ser Val Val Tyr Asn Gly His Asn Ile Tyr Ser Pro Arg Thr Asp
65 70 75 80

Thr Val Glu Leu Arg Lys Glu Ile Gly Met Val Phe Gln Gln Pro Asn

85 90 95

Pro Phe Pro Met Thr Ile Tyr Glu Asn Val Val Tyr Gly Leu Arg Ile
100 105 110

Asn Gly Ile Lys Asp Lys Gln Val Leu Asp Glu Ala Val Glu Lys Ala
115 120 125

Leu Gln Gly Ala Ser Ile Trp Asp Glu Val Lys Asp Arg Leu Tyr Asp
130 135 140

Ser Ala Ile Gly Leu Ser Gly Gly Gln Gln Gln Arg Val Cys Val Ala
145 150 155 160

Arg Val Leu Ala Thr Ser Pro Lys Ile Ile Leu Leu Asp Glu Pro Thr
165 170 175

Ser Ala Leu Asp Pro Ile Ser Ala Gly Lys Ile Glu Glu Thr Leu Tyr
180 185 190

Gly Leu Lys Asp Lys Tyr Thr Met Leu Leu Val Thr Arg Ser Met Gln
195 200 205

Gln Ala Ser Arg Ile Ser Asp Lys Thr Gly Phe Phe Leu Asp Gly Asp
210 215 220

Leu Ile Glu Phe Asn Asp Thr Lys Gln Met Phe Leu Asp Pro Gln His
225 230 235 240

Lys Glu Thr Glu Asp Tyr Ile Thr Gly Lys Phe Gly
245 250

<210> 332
<211> 294
<212> PRT
<213> Streptococcus pneumoniae

<400> 332

Met Arg Ala Lys Lys Leu Asp Lys Leu Ala Thr Ala Val Leu Tyr Thr
1 5 10 15

Ile Ala Ser Ile Ile Val Thr Ile Leu Ala Ser Leu Ile Leu Tyr Ile

20 25 30

Leu Val Arg Gly Leu Pro His Ile Ser Trp Ser Phe Leu Thr Gly Arg
35 40 45

Ser Ser Ala Phe Gln Ala Gly Gly Gly Ile Gly Ile Gln Leu Tyr Asn
50 55 60

Ser Phe Phe Leu Leu Val Ile Thr Leu Ile Ile Ser Val Pro Leu Ser
65 70 75 80

Met Gly Ala Gly Ile Tyr Leu Ala Glu Tyr Ala Lys Lys Gly Pro Val
85 90 95

Thr Asn Phe Val Arg Thr Cys Ile Glu Ile Leu Ser Ser Leu Pro Ser
100 105 110

Val Val Val Gly Leu Phe Gly Tyr Leu Ile Phe Val Val Gln Phe Glu
115 120 125

Tyr Gly Phe Ser Ile Ile Ser Gly Ala Leu Ala Leu Thr Val Phe Asn
130 135 140

Leu Pro Gln Met Thr Arg Asn Val Glu Asp Ser Leu Lys His Val His
145 150 155 160

His Thr Gln Arg Glu Ala Gly Leu Ala Leu Gly Ile Ser Arg Trp Glu
165 170 175

Thr Val Val His Val Val Ile Pro Glu Ala Leu Pro Gly Ile Val Thr
180 185 190

Gly Val Val Leu Ala Ser Gly Arg Ile Phe Gly Glu Ala Ala Ala Leu
195 200 205

Ile Tyr Thr Ala Gly Gln Ser Ala Pro Ala Leu Asp Trp Ser Asn Trp
210 215 220

Asn Ile Leu Ser Val Thr Ser Pro Ile Ser Ile Phe Arg Gln Ala Glu
225 230 235 240

Thr Leu Ala Val His Ile Trp Lys Val Asn Ser Glu Gly Thr Ile Pro
245 250 255

Asp Gly Thr Ile Val Ser Ala Gly Ser Ala Ala Val Leu Leu Ile Phe
260 265 270

Ile Leu Ile Phe Asn Phe Gly Ala Arg Lys Phe Gly Ser Tyr Leu His
275 280 285

Lys Lys Leu Thr Ala Ala
290

<210> 333
<211> 586
<212> PRT
<213> Streptococcus pneumoniae

<400> 333

Met Leu Met Lys Ile Tyr Lys Lys Leu Phe Ala Tyr Val Gln Asp Lys
1 5 10 15

Lys Tyr Leu Gly Val Leu Ala Ile Ile Phe Ser Ala Ile Ser Ala Ala
20 25 30

Leu Thr Val Tyr Gly Tyr Tyr Leu Ile Tyr Lys Phe Leu Asp Lys Leu
35 40 45

Ile Ile Asn Ser Asn Leu Ser Gly Ala Glu Ser Ile Ala Leu Lys Ser
50 55 60

Val Ile Thr Leu Thr Ser Gly Ala Ile Phe Tyr Phe Val Ser Gly Met
65 70 75 80

Phe Ser His Ile Leu Gly Phe Arg Leu Glu Thr Asn Leu Arg Lys Arg
85 90 95

Gly Ile Asp Gly Leu Glu Lys Ala Ser Phe Arg Phe Phe Asp Leu Asn
100 105 110

Pro Ser Gly Gln Ile Arg Lys Ile Ile Asp Asp Asn Ala Ala Gln Thr
115 120 125

His Gln Val Val Ala His Met Ile Pro Asp Ser Ser Gln Ala Ile Ile
    130   135   140

Thr Pro Val Leu Val Leu Ala Leu Gly Phe Ile Val Ser Ile Arg Val
145   150   155   160

Gly Ile Ile Leu Leu Ala Leu Thr Ile Ile Gly Gly Leu Ile Leu Gly
                165   170   175

Ala Met Met Gly Glu Gln Glu Phe Met Lys Ile Tyr Gln Glu Ser Leu
            180   185   190

Ser Lys Leu Ser Ala Glu Thr Val Glu Tyr Val Arg Gly Met Gln Val
        195   200   205

Val Lys Ile Phe Lys Ala Asn Val Glu Ser Phe Lys Ser Phe Tyr Lys
    210   215   220

Ala Ile Lys Asp Tyr Ser Lys Tyr Ala Tyr Asp Tyr Ser Leu Ser Cys
225   230   235   240

Lys Arg Pro Tyr Val Leu Tyr Gln Trp Leu Phe Phe Gly Leu Ile Ala
                245   250   255

Ile Leu Ile Ile Pro Ile Val Tyr Phe Met Thr Ser Leu Ala Ser Ala
            260   265   270

Lys Val Ile Leu Leu Glu Leu Ile Met Ile Leu Phe Leu Ser Gly Val
        275   280   285

Leu Phe Val Ser Phe Met Arg Met Met Trp Tyr Ser Met Tyr Ile Ser
    290   295   300

Gln Gly Asn Tyr Ala Val Asp Thr Leu Glu Ala Leu Tyr Glu Asp Met
305   310   315   320

Gln Lys Asp Lys Leu Val His Gly Asn Val Asn Asn Phe Lys Asn Tyr
                325   330   335

Asn Ile Glu Phe Glu Asn Val Ser Phe Ala Tyr Asn Asp Lys Ala Val
            340   345   350

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Ile Glu Asn Leu Ser Phe Asn Leu Glu Glu Gly Lys Ser Tyr Ala Leu
        355                 360                 365

Val Gly Ser Ser Gly Ser Gly Lys Ser Thr Val Ala Lys Leu Ile Ser
    370                 375                 380

Gly Phe Tyr Asn Val Asn Lys Gly Ser Ile Lys Ile Gly Gly Ile Ala
385                 390                 395                 400

Ile Ser Glu Tyr Ser Asp Glu Ala Leu Ile Lys Ala Ile Ser Phe Val
                405                 410                 415

Phe Gln Asp Ser Lys Leu Phe Lys Lys Ser Ile Tyr Asp Asn Val Ala
            420                 425                 430

Leu Ala Asn Lys Asp Ala Thr Lys Asp Asp Val Met Arg Ala Leu Lys
        435                 440                 445

Leu Ala Gly Cys Asp Leu Ile Leu Asp Lys Phe Pro Glu Arg Glu Asn
    450                 455                 460

Thr Ile Ile Gly Ser Lys Gly Val Tyr Leu Ser Gly Gly Glu Lys Gln
465                 470                 475                 480

Arg Ile Ala Ile Ala Arg Ala Ile Leu Lys Asp Ser Lys Ile Ile Ile
                485                 490                 495

Met Asp Glu Ala Ser Ala Ser Ile Asp Pro Asp Asn Glu Phe Glu Leu
            500                 505                 510

Gln Lys Ala Phe Lys Asn Leu Met Lys Asp Lys Thr Val Ile Met Ile
        515                 520                 525

Ala His Arg Leu Ser Thr Ile Lys Asp Leu Asp Glu Ile Ile Val Met
    530                 535                 540

Asp Ser Gly Lys Ile Ile Glu Arg Gly Ser Asp Lys Glu Leu Met Ser
545                 550                 555                 560

Lys Asp Thr Arg Tyr Lys Ser Leu Gln Glu Met Phe Asn Ser Ala Asn
                565                 570                 575
```

Glu Trp Arg Val Ser Asn Glu Arg Val Leu
580 585

<210> 334
<211> 581
<212> PRT
<213> Streptococcus pneumoniae

<400> 334

Met Arg Met Asn Gly Gly Phe Gln Met Lys Glu Phe Tyr Lys Lys Arg
1 5 10 15

Phe Ala Leu Thr Asp Gly Gly Ala Arg Asn Leu Ser Lys Ala Thr Leu
20 25 30

Ala Ser Phe Phe Val Tyr Cys Ile Asn Met Leu Pro Ala Ile Leu Leu
35 40 45

Met Ile Phe Ala Gln Glu Val Leu Glu Asn Met Gly Lys Ser Asn Gly
50 55 60

Phe Tyr Ile Val Phe Ser Val Leu Ile Leu Ile Ala Met Tyr Ile Leu
65 70 75 80

Leu Ser Ile Glu Tyr Asp Lys Leu Tyr Asn Thr Thr Tyr Gln Glu Ser
85 90 95

Ala Asp Leu Arg Ile Arg Thr Ala Glu Asn Leu Ser Lys Leu Pro Leu
100 105 110

Ser Tyr Phe Ser Lys His Asp Ile Ser Asp Ile Ser Gln Thr Ile Met
115 120 125

Ala Asp Ile Glu Gly Ile Glu His Ala Met Ser His Ser Ile Pro Lys
130 135 140

Val Gly Gly Met Val Leu Phe Phe Pro Leu Ile Ser Val Met Met Leu
145 150 155 160

Ala Gly Asn Val Lys Met Gly Leu Ala Val Ile Ile Pro Ser Ile Leu
165 170 175

Ser Phe Ile Phe Ile Pro Leu Ser Lys Lys Tyr Gln Val Asn Gly Gln
180 185 190

Asn Arg Tyr Tyr Asp Val Leu Arg Lys Asn Ser Glu Ser Phe Gln Glu
195 200 205

Asn Ile Glu Met Gln Met Glu Ile Lys Ala Tyr Asn Leu Ser Lys Asp
210 215 220

Ile Lys Asp Asp Leu Tyr Lys Lys Met Glu Asp Ser Glu Lys Val His
225 230 235 240

Leu Lys Ala Glu Val Thr Thr Ile Leu Thr Leu Ser Ile Ser Ser Ile
245 250 255

Phe Ser Phe Ile Ser Leu Ala Val Val Ile Phe Val Gly Val Asn Leu
260 265 270

Ile Ile Asn Lys Glu Ile Asn Ser Leu Tyr Leu Ile Gly Tyr Leu Leu
275 280 285

Ala Ala Met Lys Ile Lys Asp Ser Leu Asp Ala Ser Lys Glu Gly Leu
290 295 300

Met Glu Ile Phe Tyr Leu Ser Pro Lys Ile Glu Arg Leu Lys Glu Ile
305 310 315 320

Gln Asn Gln Asp Leu Gln Glu Gly Asp Asp Tyr Ser Leu Lys Lys Phe
325 330 335

Asp Ile Asp Leu Lys Asp Val Glu Phe Ala Tyr Asn Lys Asp Ala Lys
340 345 350

Val Leu Asn Gly Val Ser Phe Lys Ala Lys Gln Gly Glu Val Thr Ala
355 360 365

Leu Val Gly Ala Ser Gly Cys Gly Lys Thr Thr Ile Leu Lys Leu Ile
370 375 380

Ser Arg Leu Tyr Asp Tyr Asp Lys Gly Gln Ile Leu Ile Asp Gly Lys

385 390 395 400

Asp Ile Lys Glu Ile Ser Thr Glu Ser Leu Phe Asp Lys Val Ser Ile
405 410 415

Val Phe Gln Asp Val Val Leu Phe Asn Gln Ser Val Met Glu Asn Ile
420 425 430

Arg Ile Gly Lys Gln Asp Ala Ser Asp Glu Glu Val Lys Arg Ala Ala
435 440 445

Lys Leu Ala Asn Cys Thr Asp Phe Ile Glu Lys Met Asp Lys Gly Phe
450 455 460

Asp Thr Val Ile Gly Glu Asn Gly Ala Glu Leu Ser Gly Gly Glu Arg
465 470 475 480

Gln Arg Leu Ser Ile Ala Arg Ala Phe Leu Lys Asp Ala Pro Ile Leu
485 490 495

Ile Leu Asp Glu Ile Thr Ala Ser Leu Asp Val Asn Asn Glu Lys Lys
500 505 510

Ile Gln Glu Ser Leu Asn Asn Leu Val Lys Asp Lys Thr Val Val Ile
515 520 525

Ile Ser His Arg Met Lys Ser Ile Glu Asn Ala Asp Lys Ile Val Val
530 535 540

Leu Gln Asn Gly Arg Val Glu Ser Glu Gly Lys His Glu Glu Leu Leu
545 550 555 560

Gln Lys Ser Lys Ile Tyr Lys Asn Leu Ile Glu Lys Thr Lys Met Ala
565 570 575

Glu Glu Phe Ile Tyr
580

<210> 335
<211> 209
<212> PRT
<213> Streptococcus pneumoniae

<400> 335

Met Asp Asn Lys Lys Leu Lys Val Lys Asp Leu Val Ser Ile Gly Val
1 5 10 15

Phe Gly Val Ile Tyr Phe Ala Phe Met Phe Gly Val Gly Met Met Gly
20 25 30

Leu Ile Pro Ile Leu Phe Leu Ile Tyr Pro Thr Val Leu Ala Ile Val
35 40 45

Ala Gly Thr Val Val Met Leu Phe Met Ala Lys Val Gln Lys Pro Trp
50 55 60

Ala Leu Phe Ile Phe Gly Met Ile Ser Pro Leu Val Met Phe Ala Ala
65 70 75 80

Gly His Thr Tyr Val Val Val Val Leu Ser Leu Ile Val Met Ile Ile
85 90 95

Ala Glu Leu Ile Arg Lys Ile Gly Asn Tyr Asn Ser Phe Lys Tyr Asn
100 105 110

Met Leu Ser Tyr Ala Ile Phe Ser Thr Trp Ile Cys Ser Ser Leu Met
115 120 125

Gln Met Leu Leu Ala Lys Glu Lys Tyr Met Glu Trp Ser Leu Met Thr
130 135 140

Met Gly Lys Asp Tyr Val Asp Val Leu Glu Lys Leu Ile Thr Tyr Pro
145 150 155 160

His Met Ala Leu Val Ala Leu Gly Ala Phe Leu Gly Gly Ile Leu Gly
165 170 175

Ala Tyr Ile Gly Lys Ala Leu Leu Lys Lys His Phe Ser Asn Gly Leu
180 185 190

Tyr Cys Val Gly Tyr Phe Thr Pro Cys Leu Ile Leu Trp Cys Tyr Leu
195 200 205

Asn

<210> 336
<211> 169
<212> PRT
<213> Streptococcus pneumoniae

<400> 336

Met Cys Gly Ile Leu Tyr Ser Leu Pro Asn Phe Met Val Leu Ser Glu
1 5 10 15

Leu Asn Pro Ile Val Lys Met Phe Leu Ser Ile Pro Ile Val Ile Arg
20 25 30

Met Phe Ile Leu Pro Phe Met Ala Ala Ser Phe Met Ile Lys Thr Ser
35 40 45

Asp Val Gly Ala Ile Ile Ser Ser Met Asp Lys Leu Lys Ile Ser Lys
50 55 60

Asn Val Ser Ile Pro Ile Ala Val Met Phe Arg Phe Phe Pro Ser Phe
65 70 75 80

Lys Glu Glu Lys Lys Asn Ile Lys Met Ala Met Arg Val Arg Gly Ile
85 90 95

Asn Phe Lys Asn Pro Val Lys Tyr Leu Glu Tyr Val Ser Val Pro Leu
100 105 110

Leu Ile Ile Ser Ser Asn Ile Ser Asp Asp Ile Ala Lys Ala Ala Glu
115 120 125

Thr Lys Ala Ile Glu Asn Pro Ile Ala Lys Thr Arg Tyr Ile Arg Val
130 135 140

Lys Ile Gln Leu Ile Asp Phe Val Tyr Val Leu Ala Val Ala Gly Leu
145 150 155 160

Ile Val Gly Gly Leu Ile Trp Leu Lys
165

<210> 337
<211> 374
<212> PRT
<213> Streptococcus pneumoniae

<400> 337

Met Val Glu Ile Lys Asn Leu Ser Leu Asp Tyr Gly Glu Glu His Ile
1 5 10 15

Leu Asp Asp Ile Ser Leu Ser Ile Ala Glu Gly Glu Cys Val Leu Phe
20 25 30

Thr Gly Lys Ser Gly Asn Gly Lys Ser Ser Leu Ile Asn Ser Ile Asn
35 40 45

Gly Leu Ala Val Arg Tyr Asp Asn Ala Lys Thr Lys Gly Glu Ile Ile
50 55 60

Ile Asp Gly Lys Asn Ile Lys Asn Leu Glu Leu Tyr Gln Ile Ser Met
65 70 75 80

Leu Val Ser Thr Val Phe Gln Asn Pro Lys Thr Tyr Phe Phe Asn Val
85 90 95

Asn Thr Thr Leu Glu Leu Leu Phe Tyr Leu Glu Asn Ile Gly Leu Ala
100 105 110

Arg Glu Glu Met Asp Arg Arg Leu Lys Asp Ile Leu Glu Ile Phe Pro
115 120 125

Ile Lys Asn Leu Leu Asn Arg Asn Ile Phe Asn Leu Ser Gly Gly Glu
130 135 140

Lys Gln Ile Leu Cys Ile Ala Ala Ser Tyr Ile Ala Gly Thr Lys Ile
145 150 155 160

Ile Val Met Asp Glu Pro Ser Ser Asn Leu Asp Ile Lys Ser Ile Ser
165 170 175

Val Leu Ala Lys Met Leu Lys Ile Leu Lys Glu Lys Gly Ile Ser Ile
180 185 190

```
Ile Val Ala Glu His Arg Ile Tyr Tyr Leu Met Asp Ile Val Asp Arg
        195                 200                 205

Val Phe Leu Ile Asp Lys Gly Lys Leu Lys Lys Thr Tyr Thr Arg Ser
    210                 215                 220

Glu Phe Leu Lys Leu Asp Lys Asn Glu Leu Asn Ala Leu Ser Leu Arg
225                 230                 235                     240

Asp Lys Glu Leu Ser Lys Leu Lys Val Pro Tyr Leu Lys Glu Gly Gly
                245                 250                 255

Glu Tyr Gln Ile Lys Asn Leu Ser Tyr Lys Phe Thr Asp Asp Glu Cys
            260                 265                 270

Leu Ser Leu Lys Asp Ile Ser Phe Lys Leu Gly Lys Ile Tyr Gly Ile
        275                 280                 285

Ile Gly Ser Asn Gly Arg Gly Lys Ser Thr Leu Leu Arg Cys Leu Ile
    290                 295                 300

Gly Leu Glu Lys Lys Ser Lys Glu Glu Ile Tyr Phe Lys Gly Glu Lys
305                 310                 315                     320

Leu Ser Lys Lys Glu Arg Leu Lys Asn Ser Ser Leu Val Met Gln Asp
                325                 330                 335

Val Asn His Gln Leu Phe Thr Asp Glu Val Phe Asn Glu Leu Arg Leu
            340                 345                 350

Gly Val Lys Asn Phe Asp Glu Glu Lys Ala Lys Ile Ile Leu Asn Pro
        355                 360                 365

Asn Tyr Ser Pro Gln Ile
    370
```

<210> 338
<211> 75
<212> PRT
<213> Streptococcus pneumoniae

<400> 338

Met Ser Leu Ser Gly Gly Gln Lys Gln Arg Leu Ala Ile Ala Ser Val
1   5   10   15

Met Cys Lys Asn Ser Pro Phe Val Phe Phe Asp Glu Pro Ser Ser Gly
            20   25   30

Met Asp Tyr Ser Asn Met Ile Lys Ile Ser Glu Leu Ile Asn Lys Tyr
        35   40   45

Lys Thr Met Asp Lys Ile Ile Phe Ile Val Ser His Asp Ile Glu Phe
    50   55   60

Leu Asn Glu Val Ala Asp Glu Ile Phe Glu Leu
65   70   75

<210> 339
<211> 318
<212> PRT
<213> Streptococcus pneumoniae

<400> 339

Met Asp Ile Arg Pro Gln Ser Ser Asp Glu Leu Asp Ser Gln Arg Arg
1   5   10   15

Val Arg Arg Asp Met Ser Asn Ser Leu Lys Gly Thr Leu Leu Thr Val
            20   25   30

Val Ala Gly Ile Ala Trp Gly Leu Ser Gly Thr Ser Gly Gln Tyr Leu
        35   40   45

Met Ala His Gly Ile Ser Ala Leu Val Leu Thr Asn Leu Arg Leu Leu
    50   55   60

Ile Ala Gly Gly Ile Leu Met Leu Leu Ala Tyr Ala Thr Ala Lys Asp
65   70   75   80

Lys Ile Leu Val Phe Leu Lys Asp Arg Lys Ser Leu Leu Ser Leu Leu
                85   90   95

Ile Phe Ala Leu Ile Gly Leu Phe Leu Asn Gln Phe Ala Tyr Leu Ser
            100   105   110

```
Ala Ile Gln Glu Thr Asn Ala Gly Thr Ala Thr Val Leu Gln Tyr Val
        115                 120                 125

Cys Pro Val Gly Ile Leu Ile Tyr Ser Cys Ile Lys Asp Arg Val Ala
    130                 135                 140

Pro Thr Leu Gly Glu Ile Val Ser Ile Ile Phe Ala Ile Gly Gly Thr
145                 150                 155                 160

Phe Leu Ile Ala Thr His Gly Gln Leu Asp Gln Leu Ser Met Thr Pro
                165                 170                 175

Ala Gly Leu Phe Trp Gly Leu Phe Ser Ala Leu Thr Tyr Ala Leu Tyr
            180                 185                 190

Ile Ile Leu Pro Ile Ala Leu Ile Lys Lys Trp Gly Ser Ser Leu Val
        195                 200                 205

Ile Gly Val Gly Met Val Ile Ala Gly Leu Val Ala Leu Pro Phe Thr
    210                 215                 220

Gly Val Leu Gln Ala Asp Ile Pro Thr Ser Leu Asp Phe Leu Leu Ala
225                 230                 235                 240

Phe Ala Gly Ile Ile Leu Ile Gly Thr Val Phe Ala Tyr Thr Ala Phe
                245                 250                 255

Leu Lys Gly Ala Ser Leu Ile Gly Pro Val Lys Ser Ser Leu Leu Ala
            260                 265                 270

Ser Ile Glu Pro Ile Ser Ala Ile Phe Phe Ala Phe Leu Ile Met Asn
        275                 280                 285

Glu Gln Phe Tyr Pro Ile Asp Phe Leu Gly Met Ala Met Ile Leu Phe
    290                 295                 300

Ala Val Thr Leu Ile Ser Leu Lys Asp Leu Phe Leu Glu Lys
305                 310                 315
```

<210> 340
<211> 79
<212> PRT

<213> Streptococcus pneumoniae

<400> 340

Met Leu Leu Leu Ala Lys Glu Lys Val Ala Cys Leu Leu Thr Val Thr
1 5 10 15

Cys Leu Ala Met Leu Phe Ala Met Pro Ala Leu Leu Leu Thr Thr Leu
20 25 30

Thr Lys Met Glu Lys Asn Thr Val Ser Asn Ser Lys Ala Thr Thr Pro
35 40 45

Leu Leu Phe Ser Met Lys Leu Thr Thr Leu Thr Val Ser Cys Phe Thr
50 55 60

Ile Ala Ser Met Lys Lys Thr His Leu Gln Leu Lys Met Val Tyr
65 70 75

<210> 341
<211> 78
<212> PRT
<213> Streptococcus pneumoniae

<400> 341

Met Arg Glu Ile Met Leu Leu Gln Leu Phe Ser Leu Tyr Phe Glu Ser
1 5 10 15

Leu Ile Leu Thr Thr Ile Leu Val Leu Ile Phe Leu Gly Ile Trp Ile
20 25 30

Gly Leu Arg Ala Met Ser Gly Val Asp Lys Thr Ala Arg Ala Arg Gln
35 40 45

Ala His Leu Tyr Asp Met Ile Met Ile Gly Val Leu Val Val Pro Val
50 55 60

Leu Ser Phe Ala Val Met Ser Leu Ile Leu Val Phe Lys Ala
65 70 75

<210> 342
<211> 176
<212> PRT
<213> Streptococcus pneumoniae

<400> 342

Met Gln Lys Lys Tyr Val Lys Ile Leu Tyr Ser Ser Pro Ile Gly Ile
1 5 10 15

Leu Ser Leu Val Ala Asp Asp His Tyr Leu Tyr Gly Ile Trp Val Gln
20 25 30

Glu Gln Lys His Phe Glu Arg Gly Leu Gly Asp Glu Thr Ile Glu Glu
35 40 45

Val Val Ser His Pro Ile Leu Asp Pro Val Ile Ala Cys Leu Asp Asp
50 55 60

Tyr Phe Lys Gly Lys Pro Gln Asp Leu Ser Asn Leu Leu Leu Ala Pro
65 70 75 80

Ile Gly Thr Asn Phe Glu Lys Arg Val Trp Asp Tyr Leu Gln Gly Ile
85 90 95

Pro Tyr Gly Gln Thr Val Thr Tyr Gly Gln Ile Ala Gln Asp Leu Gln
100 105 110

Val Ala Ser Ala Gln Ala Ile Gly Gly Ala Val Gly Arg Asn Pro Trp
115 120 125

Ser Ile Leu Val Pro Cys His Arg Val Leu Gly Ala Gly Lys Arg Leu
130 135 140

Thr Gly Tyr Ala Ala Gly Val Glu Lys Lys Ala Trp Leu Leu Glu His
145 150 155 160

Glu Gly Val Asp Phe Lys Asp Arg Ser Asn Arg Arg Arg Ser Thr Cys
165 170 175

<210> 343
<211> 480
<212> PRT
<213> Streptococcus pneumoniae

<400> 343

Met Pro Asn Cys Ile Ile Glu Ile Ile Ala Gln Ile Cys Tyr Asp Ile

```
1               5                   10                  15

Asn Met Asn Lys Ser Arg Leu Gly Arg Gly Arg His Gly Lys Thr Arg
            20                  25                  30

His Val Leu Leu Ala Leu Ile Gly Ile Leu Ala Ile Ser Ile Cys Leu
        35                  40                  45

Leu Gly Gly Phe Ile Ala Phe Lys Ile Tyr Gln Gln Lys Ser Phe Glu
    50                  55                  60

Gln Lys Ile Glu Ser Leu Lys Lys Glu Lys Asp Asp Gln Leu Ser Glu
65                  70                  75                  80

Gly Asn Gln Lys Glu His Phe Arg Gln Gly Gln Ala Glu Val Ile Ala
                85                  90                  95

Tyr Tyr Pro Leu Gln Gly Glu Lys Val Ile Ser Ser Val Arg Glu Leu
            100                 105                 110

Ile Asn Gln Asp Val Lys Asp Lys Leu Glu Ser Lys Asp Asn Leu Val
        115                 120                 125

Phe Tyr Tyr Thr Glu Gln Glu Glu Ser Gly Leu Lys Gly Val Val Asn
    130                 135                 140

Arg Asn Val Thr Lys Gln Ile Tyr Asp Leu Val Ala Phe Lys Ile Glu
145                 150                 155                 160

Glu Thr Glu Lys Thr Ser Leu Gly Lys Val His Leu Thr Glu Asp Gly
                165                 170                 175

Gln Pro Phe Thr Leu Asp Gln Leu Phe Ser Asp Ala Ser Lys Ala Lys
            180                 185                 190

Glu Gln Leu Ile Lys Glu Leu Thr Ser Phe Ile Glu Asp Lys Lys Ile
        195                 200                 205

Glu Gln Asp Gln Ser Glu Gln Ile Val Lys Asn Phe Ser Asp Gln Asp
    210                 215                 220
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Leu Ser Ala Trp Asn Phe Asp Tyr Lys Asp Ser Gln Ile Ile Leu Tyr
225                 230                 235                 240

Pro Ser Pro Val Val Glu Asn Leu Glu Glu Ile Ala Leu Pro Val Ser
                245                 250                 255

Ala Phe Phe Asp Val Ile Gln Ser Ser Tyr Leu Leu Glu Lys Asp Ala
            260                 265                 270

Ala Leu Tyr Gln Ser Tyr Phe Asp Lys Lys His Gln Lys Val Val Ala
        275                 280                 285

Leu Thr Phe Asp Asp Gly Pro Asn Pro Ala Thr Thr Pro Gln Val Leu
    290                 295                 300

Glu Thr Leu Ala Lys Tyr Asp Ile Lys Ala Thr Phe Phe Val Leu Gly
305                 310                 315                 320

Lys Asn Val Ser Gly Asn Glu Asp Leu Val Lys Arg Ile Lys Ser Glu
                325                 330                 335

Gly His Val Val Gly Asn His Ser Trp Ser His Pro Ile Leu Ser Gln
            340                 345                 350

Leu Ser Leu Asp Glu Ala Lys Lys Gln Ile Thr Asp Thr Glu Asp Val
        355                 360                 365

Leu Thr Lys Val Leu Gly Ser Ser Ser Lys Leu Met Arg Pro Pro Tyr
    370                 375                 380

Gly Ala Ile Thr Asp Asp Ile Arg Asn Ser Leu Asp Leu Ser Phe Ile
385                 390                 395                 400

Met Trp Asp Val Asp Ser Leu Asp Trp Lys Ser Lys Asn Glu Ala Ser
                405                 410                 415

Ile Leu Thr Glu Ile Gln Tyr Gln Val Ala Asn Gly Ser Ile Val Leu
            420                 425                 430

Met His Asp Ile His Ser Pro Thr Val Asn Ala Leu Pro Arg Val Ile
        435                 440                 445
```

Glu Tyr Leu Lys Asn Gln Gly Tyr Thr Phe Val Thr Ile Pro Glu Met
    450   455   460

Leu Asn Thr Arg Leu Lys Ala His Glu Leu Tyr Tyr Ser Arg Asp Glu
465   470   475   480

<210> 344
<211> 232
<212> PRT
<213> Streptococcus pneumoniae

<400> 344

Met Val Ile Leu Phe Ile His Ala Ile Ile Gly Thr Ile Thr Phe Arg
1   5   10   15

Arg Cys Ser Met Ser Tyr Leu Phe Glu Ile Leu Pro Ser Leu Leu Asn
            20   25   30

Gly Ala Ser Thr Thr Val Gln Val Phe Ala Leu Val Leu Leu Phe Ser
        35   40   45

Ile Pro Leu Gly Val Leu Ile Ala Phe Ala Leu Gln Val His Trp Lys
    50   55   60

Pro Leu His Tyr Leu Ile Asn Ile Tyr Ile Trp Val Met Arg Gly Thr
65   70   75   80

Pro Leu Leu Leu Gln Leu Ile Phe Ile Tyr Tyr Val Leu Pro Ser Ile
                85   90   95

Gly Ile Arg Leu Asp Arg Leu Pro Ala Ala Ile Ile Ala Phe Val Leu
            100   105   110

Asn Tyr Ala Ala Tyr Phe Ala Glu Ile Phe Arg Gly Gly Ile Asp Thr
        115   120   125

Ile Pro Arg Gly Gln Tyr Glu Ala Ala Lys Val Leu Lys Phe Ser Pro
    130   135   140

Phe Asp Arg Val Arg Tyr Ile Ile Leu Pro Gln Val Thr Lys Ile Val
145   150   155   160

Leu Pro Ser Val Phe Asn Glu Val Met Ser Leu Val Lys Asp Thr Ser
165 170 175

Leu Val Tyr Ala Leu Gly Ile Ser Asp Leu Ile Leu Ala Ser Arg Thr
180 185 190

Ala Ala Asn Arg Asp Ala Ser Leu Val Pro Met Phe Leu Ala Gly Ala
195 200 205

Ile Tyr Leu Ile Leu Ile Gly Ile Val Thr Ile Ile Ser Lys Lys Val
210 215 220

Glu Lys Lys Tyr Ser Tyr Tyr Arg
225 230

<210> 345
<211> 238
<212> PRT
<213> Streptococcus pneumoniae

<400> 345

Met Glu Glu Ser Ile Asn Pro Ile Ile Ser Ile Gly Pro Val Ile Phe
1 5 10 15

Asn Leu Thr Met Leu Ala Met Thr Leu Leu Ile Val Gly Val Ile Phe
20 25 30

Val Phe Ile Tyr Trp Ala Ser Arg Asn Met Thr Leu Lys Pro Lys Gly
35 40 45

Lys Gln Asn Val Leu Glu Tyr Val Tyr Asp Phe Val Ile Gly Phe Thr
50 55 60

Glu Pro Asn Ile Gly Ser Arg Tyr Met Lys Asp Tyr Ser Leu Phe Phe
65 70 75 80

Leu Cys Leu Phe Leu Phe Met Val Ile Ala Asn Asn Leu Gly Leu Met
85 90 95

Thr Lys Leu Gln Thr Ile Asp Gly Thr Asn Trp Trp Ser Ser Pro Thr
100 105 110

Ala Asn Leu Gln Tyr Asp Leu Thr Leu Ser Phe Leu Val Ile Leu Leu
115 120 125

Thr His Ile Glu Ser Val Arg Arg Arg Gly Phe Lys Lys Ser Ile Lys
130 135 140

Ser Phe Met Ser Pro Val Phe Val Ile Pro Met Asn Ile Leu Glu Glu
145 150 155 160

Phe Thr Asn Phe Leu Ser Leu Ala Leu Arg Ile Phe Gly Asn Ile Phe
165 170 175

Ala Gly Glu Val Met Thr Ser Leu Leu Leu Leu Leu Ser His Gln Ala
180 185 190

Ile Tyr Trp Tyr Pro Val Ala Phe Gly Ala Asn Leu Ala Trp Thr Ala
195 200 205

Phe Ser Val Phe Ile Ser Cys Ile Gln Ala Tyr Val Phe Thr Leu Leu
210 215 220

Thr Ser Val Tyr Leu Gly Asn Lys Ile Asn Ile Glu Glu Glu
225 230 235

<210> 346
<211> 551
<212> PRT
<213> Streptococcus pneumoniae

<400> 346

Met Ser Glu Lys Ser Arg Glu Glu Glu Lys Leu Ser Phe Lys Glu Gln
1 5 10 15

Ile Leu Arg Asp Leu Glu Lys Val Lys Gly Tyr Asp Glu Val Leu Lys
20 25 30

Glu Asp Glu Ala Val Val Arg Thr Pro Ala Asn Glu Pro Ser Thr Glu
35 40 45

Glu Leu Met Ala Asp Ser Leu Ser Thr Val Glu Glu Ile Met Arg Lys
50 55 60

Ala Pro Thr Val Pro Thr His Pro Ser Gln Gly Val Pro Ala Ser Pro
65 70 75 80

Ala Asp Glu Ile Gln Arg Glu Thr Pro Gly Val Pro Ser His Pro Ser
85 90 95

Gln Asp Val Pro Ser Ser Pro Ala Glu Glu Ser Gly Ser Arg Pro Gly
100 105 110

Pro Gly Pro Val Arg Pro Lys Lys Leu Glu Arg Glu Tyr Asn Glu Thr
115 120 125

Pro Thr Arg Val Ala Val Ser Tyr Thr Thr Ala Glu Lys Lys Ala Glu
130 135 140

Gln Ala Gly Pro Glu Thr Pro Thr Pro Ala Thr Glu Thr Val Asp Ile
145 150 155 160

Ile Arg Asp Thr Ser Arg Arg Ser Arg Arg Glu Gly Ala Lys Pro Val
165 170 175

Lys Pro Lys Lys Glu Lys Lys Ser His Val Lys Ala Phe Val Ile Ser
180 185 190

Phe Leu Val Phe Leu Ala Leu Leu Ser Ala Gly Gly Tyr Phe Gly Tyr
195 200 205

Gln Tyr Val Leu Asp Ser Leu Leu Pro Ile Asp Ala Asn Ser Lys Lys
210 215 220

Tyr Val Thr Val Gly Ile Pro Glu Gly Ser Asn Val Gln Glu Ile Gly
225 230 235 240

Thr Thr Leu Glu Lys Ala Gly Leu Val Lys His Gly Leu Ile Phe Ser
245 250 255

Phe Tyr Ala Lys Tyr Lys Asn Tyr Thr Asp Leu Lys Ala Gly Tyr Tyr
260 265 270

Asn Leu Gln Lys Ser Met Ser Thr Glu Asp Leu Leu Lys Glu Leu Gln
275 280 285

Lys Gly Gly Thr Asp Glu Pro Gln Glu Pro Val Leu Ala Thr Leu Thr
    290   295   300

Ile Pro Glu Gly Tyr Thr Leu Asp Gln Ile Ala Gln Ala Val Gly Gln
305   310   315   320

Leu Gln Gly Asp Phe Lys Glu Ser Leu Thr Ala Glu Ala Phe Leu Ala
                325   330   335

Lys Val Gln Asp Glu Thr Phe Ile Ser Gln Ala Val Ala Lys Tyr Pro
            340   345   350

Thr Leu Leu Glu Ser Leu Pro Val Lys Asp Ser Gly Ala Arg Tyr Arg
        355   360   365

Leu Glu Gly Tyr Leu Phe Pro Ala Thr Tyr Ser Ile Lys Glu Ser Thr
    370   375   380

Thr Ile Glu Ser Leu Ile Asp Glu Met Leu Ala Ala Met Asp Lys Asn
385   390   395   400

Leu Ser Pro Tyr Tyr Ser Thr Ile Lys Ser Lys Asn Leu Thr Val Asn
                405   410   415

Glu Leu Leu Thr Ile Ala Ser Leu Val Glu Lys Glu Gly Ala Lys Thr
            420   425   430

Glu Asp Arg Lys Leu Ile Ala Gly Val Phe Tyr Asn Arg Leu Asn Arg
        435   440   445

Asp Met Pro Leu Gln Ser Asn Ile Ala Ile Leu Tyr Ala Gln Gly Lys
    450   455   460

Leu Gly Gln Asn Ile Ser Leu Ala Glu Asp Val Ala Ile Asp Thr Asn
465   470   475   480

Ile Asp Ser Pro Tyr Asn Val Tyr Lys Asn Val Gly Leu Met Pro Gly
                485   490   495

Pro Val Asp Ser Pro Ser Leu Asp Ala Ile Glu Ser Ser Ile Asn Gln

500 505 510

Thr Lys Ser Asp Asn Leu Tyr Phe Val Ala Asp Val Thr Glu Gly Lys
515 520 525

Val Tyr Tyr Ala Asn Asn Gln Glu Asp His Asp Arg Asn Val Ala Glu
530 535 540

His Val Asn Ser Lys Leu Asn
545 550

<210> 347
<211> 222
<212> PRT
<213> Streptococcus pneumoniae

<400> 347

Met Leu Thr Tyr Gly Gly Tyr Arg Val Ser Ala Gly Tyr Ile Ser Val
1 5 10 15

Gly Thr Leu Val Ser Phe Leu Ile Tyr Leu Phe Gln Leu Leu Asn Pro
20 25 30

Ile Ser Asn Ile Ala Asn Phe Val Thr Val Tyr Ser Arg Ser Lys Gly
35 40 45

Ser Ser Val Ala Leu Glu Asn Leu Leu Ala Val Pro Lys Glu Lys Phe
50 55 60

Glu Gly Gly Lys Ser Val Ser Gly Arg Gly Leu Asn Phe Asn His Val
65 70 75 80

Tyr Phe Gly Tyr Asp Glu Asn Arg Pro Val Leu Lys Asp Ile Thr Cys
85 90 95

Ser Ile Phe Lys Gly Gln Lys Ile Ala Phe Val Gly Pro Ser Gly Ser
100 105 110

Gly Lys Ser Thr Ile Val Arg Leu Leu Glu Arg Phe Tyr Lys Pro Leu
115 120 125

Ser Gly Asp Ile Leu Met Glu Gln Ser Ser Ile Tyr Asp Phe Asn Leu

130 135 140

Lys Glu Trp Arg Ser Lys Ile Ala Trp Val Ser Gln Asn Asn Ala Val
145 150 155 160

Leu Ser Gly Ser Ile Arg Asp Asn Leu Cys Leu Gly Leu Asn Arg Leu
165 170 175

Val Thr Asp Asp Glu Leu Met Lys Val Leu Asp Leu Val Ser Leu Gly
180 185 190

Asp Glu Ile Arg Ser Met Lys Glu Gly Leu Asp Thr Glu Val Gly Glu
195 200 205

Arg Gly Arg Leu Leu Ser Gly Gly Arg Thr Lys Asp Phe Lys
210 215 220

<210> 348
<211> 181
<212> PRT
<213> Streptococcus pneumoniae

<400> 348

Met Lys Leu Lys Leu Leu Arg Val Asp Thr Lys Val Ile Met Gly Ser
1 5 10 15

Phe Leu Leu Val Leu Ser Ser Leu Leu Ala Leu Leu Leu Pro Leu Ile
20 25 30

Leu Lys Asp Leu Ile Asp Gly Ser Ser Ile Glu Asn Ile Gly Ser Lys
35 40 45

Val Phe Gln Ser Phe Leu Ile Phe Ile Gly Gln Ala Leu Phe Ser Ser
50 55 60

Ile Gly Tyr Tyr Leu Phe Ser Gln Ser Gly Glu Lys Lys Ile Ala Lys
65 70 75 80

Ile Arg Lys Lys Val Ile Glu Gly Leu Ile Tyr Val Glu Lys Ser Phe
85 90 95

Phe Asp Lys Ser Gln Ser Gly Glu Leu Thr Ser Ala Ile Val Asn Asp

100 105 110

Thr Ser Val Ile Arg Glu Phe Leu Ile Thr Thr Phe Pro Asn Ile Ile
115 120 125

Leu Ser Leu Val Met Val Leu Gly Ser Ile Val Val Leu Phe Ser Leu
130 135 140

Asp Trp Asn Leu Ser Leu Leu Leu Phe Ile Thr Leu Pro Cys Met Met
145 150 155 160

Phe Ile Ile Leu Pro Leu Ser Asn Ile Ser Glu Lys Tyr Ser Arg Arg
165 170 175

Leu Gln Glu Glu Ile
180

<210> 349
<211> 652
<212> PRT
<213> Streptococcus pneumoniae

<400> 349

Met Lys Lys Ser Lys Ser Lys Tyr Leu Thr Leu Ala Gly Leu Val Leu
1 5 10 15

Gly Thr Gly Val Leu Leu Ser Ala Cys Gly Asn Ser Ser Thr Ala Ser
20 25 30

Lys Thr Tyr Asn Tyr Val Tyr Ser Ser Asp Pro Ser Ser Leu Asn Tyr
35 40 45

Leu Ala Glu Asn Arg Ala Ala Thr Ser Asp Ile Val Ala Asn Leu Val
50 55 60

Asp Gly Leu Leu Glu Asn Asp Gln Tyr Gly Asn Ile Ile Pro Ser Leu
65 70 75 80

Ala Glu Asp Trp Thr Val Ser Gln Asp Gly Leu Thr Tyr Thr Tyr Lys
85 90 95

Leu Arg Lys Asp Ala Lys Trp Phe Thr Ser Glu Gly Glu Glu Tyr Ala

100 105 110

Pro Val Thr Ala Gln Asp Phe Val Thr Gly Leu Gln Tyr Ala Ala Asp
115 120 125

Lys Lys Ser Glu Ala Leu Tyr Leu Val Gln Asp Ser Val Ala Gly Leu
130 135 140

Asp Asp Tyr Ile Thr Gly Lys Thr Ser Asp Phe Ser Thr Val Gly Val
145 150 155 160

Lys Ala Leu Asp Asp Gln Thr Val Gln Tyr Thr Leu Val Lys Pro Glu
165 170 175

Leu Tyr Trp Asn Ser Lys Thr Leu Ala Thr Ile Leu Phe Pro Val Asn
180 185 190

Ala Asp Phe Leu Lys Ser Lys Gly Asp Asp Phe Gly Lys Ala Asp Pro
195 200 205

Ser Ser Ile Leu Tyr Asn Gly Pro Phe Leu Met Lys Ala Leu Val Ser
210 215 220

Lys Ser Ala Ile Glu Tyr Lys Lys Asn Pro Asn Tyr Trp Asp Ala Lys
225 230 235 240

Asn Val Phe Val Asp Asp Val Lys Leu Thr Tyr Tyr Asp Gly Ser Asp
245 250 255

Gln Glu Ser Leu Glu Arg Asn Phe Thr Ala Gly Ala Tyr Thr Thr Ala
260 265 270

Arg Leu Phe Pro Asn Ser Ser Ser Tyr Glu Gly Ile Lys Glu Lys Tyr
275 280 285

Lys Asn Asn Ile Ile Tyr Ser Met Gln Asn Ser Thr Ser Tyr Phe Phe
290 295 300

Asn Phe Asn Leu Asp Arg Lys Ser Tyr Asn Tyr Thr Ser Lys Thr Ser
305 310 315 320

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Asp Ile Glu Lys Lys Ser Thr Gln Glu Ala Val Leu Asn Lys Asn Phe
                325                 330                 335

Arg Gln Ala Ile Asn Phe Ala Phe Asp Arg Thr Ser Tyr Gly Ala Gln
            340                 345                 350

Ser Glu Gly Lys Glu Gly Ala Thr Lys Ile Leu Arg Asn Leu Val Val
        355                 360                 365

Pro Pro Asn Phe Val Ser Ile Lys Gly Lys Asp Phe Gly Glu Val Val
    370                 375                 380

Ala Ser Lys Met Val Asn Tyr Gly Lys Glu Trp Gln Gly Ile Asn Phe
385                 390                 395                 400

Ala Asp Gly Gln Asp Pro Tyr Tyr Asn Pro Glu Lys Ala Lys Ala Lys
                405                 410                 415

Phe Ala Glu Ala Lys Lys Glu Leu Glu Ala Lys Gly Val Gln Phe Pro
            420                 425                 430

Ile His Leu Asp Lys Thr Val Glu Val Thr Asp Lys Val Gly Ile Gln
        435                 440                 445

Gly Val Ser Ser Ile Lys Gln Ser Ile Glu Ser Val Leu Gly Ser Asp
    450                 455                 460

Asn Val Val Ile Asp Ile Gln Gln Leu Thr Ser Asp Glu Phe Asp Ser
465                 470                 475                 480

Ser Gly Tyr Phe Ala Gln Thr Ala Ala Gln Lys Asp Tyr Asp Leu Tyr
                485                 490                 495

His Gly Gly Trp Gly Pro Asp Tyr Gln Asp Pro Ser Thr Tyr Leu Asp
            500                 505                 510

Ile Phe Asn Thr Asn Ser Gly Gly Phe Leu Gln Asn Leu Gly Leu Glu
        515                 520                 525

Pro Gly Glu Ala Asn Asp Lys Ala Lys Ala Val Gly Leu Asp Val Tyr
    530                 535                 540
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Thr Gln Met Leu Glu Glu Ala Asn Lys Glu Gln Asp Pro Ala Lys Arg
545 550 555 560

Tyr Glu Lys Tyr Ala Asp Ile Gln Ala Trp Leu Ile Asp Ser Ser Leu
565 570 575

Val Leu Pro Ser Val Ser Arg Gly Gly Thr Pro Ser Leu Arg Arg Thr
580 585 590

Val Pro Phe Ala Ala Ala Tyr Gly Leu Thr Gly Thr Lys Gly Val Glu
595 600 605

Ser Tyr Lys Tyr Leu Lys Val Gln Asp Lys Ile Val Thr Thr Asp Glu
610 615 620

Tyr Ala Lys Ala Arg Glu Lys Trp Leu Lys Glu Lys Glu Glu Ser Asn
625 630 635 640

Lys Lys Ala Gln Glu Glu Leu Ala Lys His Val Lys
645 650

<210> 350
<211> 545
<212> PRT
<213> Streptococcus pneumoniae

<400> 350

Met Asn Glu Glu Ser Met Ser His Glu Asn Asn His Gln Gln Ala Gln
1 5 10 15

Met Leu Arg Gly Thr Ala Trp Leu Thr Ala Ser Asn Phe Ile Ser Arg
20 25 30

Leu Leu Gly Ala Val Tyr Ile Ile Pro Trp Tyr Ile Trp Met Gly Ala
35 40 45

Tyr Ala Ala Lys Ala Asn Gly Leu Phe Thr Met Gly Tyr Asn Ile Tyr
50 55 60

Ala Trp Phe Leu Leu Val Ser Thr Ala Gly Ile Pro Val Ala Val Ala
65 70 75 80

Lys Gln Val Ala Lys Tyr Asn Thr Met Arg Glu Glu Glu His Ser Phe
85 90 95

Ala Leu Ile Arg Ser Phe Leu Gly Phe Met Thr Gly Leu Gly Leu Val
100 105 110

Phe Ala Leu Val Leu Tyr Val Phe Ala Pro Trp Leu Ala Asp Leu Ser
115 120 125

Gly Val Gly Lys Asp Leu Ile Pro Ile Met Gln Ser Leu Ala Trp Gly
130 135 140

Val Leu Ile Phe Pro Ser Met Ser Val Ile Arg Gly Phe Phe Gln Gly
145 150 155 160

Met Asn Asn Leu Lys Pro Tyr Ala Met Ser Gln Ile Ala Glu Gln Val
165 170 175

Ile Arg Val Ile Trp Met Leu Leu Ala Thr Phe Ile Ile Met Lys Leu
180 185 190

Gly Ser Gly Asp Tyr Leu Ala Ala Val Thr Gln Ser Thr Phe Ala Ala
195 200 205

Phe Val Gly Met Val Ala Ser Phe Ala Val Leu Ile Tyr Phe Leu Ala
210 215 220

Gln Glu Gly Ser Leu Lys Arg Ile Phe Glu Thr Gly Asp Lys Ile Asn
225 230 235 240

Ser Lys Arg Leu Leu Val Asp Thr Ile Lys Glu Ala Ile Pro Phe Ile
245 250 255

Leu Thr Gly Ser Ala Ile Gln Leu Phe Gln Ile Leu Asp Gln Leu Thr
260 265 270

Phe Ile Asn Ser Met Ser Trp Phe Thr Asn Tyr Ser Asn Glu Asp Leu
275 280 285

Val Val Met Phe Ser Tyr Phe Ser Ala Asn Pro Asn Lys Ile Thr Met
290 295 300

Ile Leu Ile Ser Val Gly Val Ser Ile Gly Ser Val Gly Leu Pro Leu
305 310 315 320

Leu Thr Glu Asn Tyr Val Lys Gly Asp Leu Lys Ala Ala Ser Arg Leu
325 330 335

Val Gln Asp Ser Leu Thr Leu Leu Phe Met Phe Leu Leu Pro Ala Thr
340 345 350

Val Gly Val Val Met Val Gly Glu Pro Leu Tyr Thr Val Phe Tyr Gly
355 360 365

Lys Pro Asp Ser Leu Ala Leu Gly Leu Phe Val Phe Ala Val Leu Gln
370 375 380

Ser Ile Ile Leu Gly Leu Tyr Met Val Leu Ser Pro Met Leu Gln Ala
385 390 395 400

Met Phe Arg Asn Arg Lys Ala Val Leu Tyr Phe Ile Tyr Gly Ser Ile
405 410 415

Ala Lys Leu Val Leu Gln Leu Pro Thr Ile Ala Leu Phe His Ser Tyr
420 425 430

Gly Pro Leu Ile Ser Thr Thr Ile Ala Leu Ile Ile Pro Asn Val Leu
435 440 445

Met Tyr Arg Asp Ile Cys Lys Val Thr Gly Val Lys Arg Lys Val Ile
450 455 460

Leu Lys Arg Thr Ile Leu Ile Ser Leu Leu Thr Leu Val Met Phe Leu
465 470 475 480

Leu Ile Gly Thr Ile Gln Trp Leu Leu Gly Phe Phe Phe Gln Pro Ser
485 490 495

Gly Arg Leu Trp Ser Phe Phe Tyr Val Ala Leu Val Gly Ala Met Gly
500 505 510

Gly Gly Leu Tyr Met Val Met Ser Leu Arg Thr Tyr Leu Leu Asp Lys

515 520 525

Val Ile Gly Lys Ala Gln Ala Asp Arg Leu Arg Ala Lys Phe Lys Leu
530 535 540

Ser
545

<210> 351
<211> 209
<212> PRT
<213> Streptococcus pneumoniae

<400> 351

Met Gln Val Leu Leu Phe Cys Cys Asn Ile Phe Tyr Asn Asn Glu Arg
1 5 10 15

Val Leu Glu Ile Leu Arg Lys Arg Arg His Ile Met Ser Lys Lys Val
20 25 30

Leu Phe Ile Val Gly Ser Leu Arg Gln Gly Ser Phe Asn His Gln Met
35 40 45

Ala Leu Glu Ala Glu Lys Ala Leu Ala Gly Lys Ala Glu Val Ser Tyr
50 55 60

Leu Asp Tyr Ser Ala Leu Pro Leu Phe Ser Gln Asp Leu Glu Val Pro
65 70 75 80

Thr His Pro Ala Val Ala Ala Ala Arg Glu Ala Val Leu Val Ala Asp
85 90 95

Ala Ile Trp Ile Phe Ser Pro Val Tyr Asn Phe Ser Ile Pro Gly Thr
100 105 110

Val Lys Asn Leu Leu Asp Trp Leu Ser Arg Ala Leu Asp Leu Ser Asp
115 120 125

Thr Arg Gly Val Ser Ala Leu Gln Asp Lys Phe Val Thr Val Ser Ser
130 135 140

Val Ala Asn Ala Gly His Asp Gln Leu Phe Ala Ile Tyr Lys Asp Leu

145 150 155 160

Leu Pro Phe Ile Arg Thr Gln Gly Val Gly Asp Phe Thr Ala Ala Arg
165 170 175

Val Asn Asp Ser Ala Trp Ala Asp Gly Lys Leu Val Leu Glu Glu Thr
180 185 190

Val Leu Asn Ser Leu Glu Lys Gln Ala Gln Asp Leu Val Glu Ala Ile
195 200 205

Lys

<210> 352
<211> 623
<212> PRT
<213> Streptococcus pneumoniae

<400> 352

Met Ser Asp Phe Ile Val Glu Lys Leu Ser Lys Ser Val Gly Asp Lys
1 5 10 15

Thr Val Phe Arg Asp Ile Ser Phe Ile Ile His Asp Leu Asp Arg Ile
20 25 30

Gly Leu Ile Gly Val Asn Gly Thr Gly Lys Thr Thr Leu Leu Asp Val
35 40 45

Leu Ser Gly Val Ser Gly Phe Asp Gly Asp Val Ser Pro Phe Ser Ala
50 55 60

Lys Asn Asp Tyr Gln Ile Gly Tyr Leu Thr Gln Asp Pro Asp Phe Asp
65 70 75 80

Asp Arg Lys Thr Val Leu Asp Thr Val Leu Ser Ser Glu Leu Lys Glu
85 90 95

Ile Gln Leu Ile Arg Glu Tyr Glu Leu Ile Met Leu Asp Tyr Ser Glu
100 105 110

Asp Lys Gln Ala Arg Leu Glu Arg Val Met Ala Glu Met Asp Ser Leu

115 120 125

Gln Ala Trp Glu Ile Glu Ser Gln Val Lys Thr Val Leu Ser Lys Leu
130 135 140

Gly Ile Gln Asp Leu Ser Thr Pro Val Gly Glu Leu Ser Gly Gly Leu
145 150 155 160

Arg Arg Arg Val Gln Leu Ala Gln Val Leu Leu Gly Asn His Asp Leu
165 170 175

Leu Leu Leu Asp Glu Pro Thr Asn His Leu Asp Ile Ala Ile Ile Glu
180 185 190

Trp Leu Thr Leu Phe Leu Lys Asn Ser Lys Lys Thr Val Leu Phe Ile
195 200 205

Thr His Asp Arg Tyr Phe Leu Asp Ala Leu Ser Thr Arg Ile Phe Glu
210 215 220

Leu Asp Arg Ala Gly Leu Thr Glu Tyr Gln Gly Asn Tyr Gln Asp Tyr
225 230 235 240

Val Arg Leu Lys Ala Glu Gln Asp Glu Arg Asp Ala Ala Leu Leu His
245 250 255

Lys Lys Glu Gln Leu Tyr Lys Gln Glu Leu Ala Trp Met Arg Arg Gln
260 265 270

Pro Gln Ala Arg Ala Thr Lys Gln Gln Ala Arg Ile Asn Arg Phe His
275 280 285

Asp Leu Lys Lys Glu Val Ser Gly Ser Ser Ala Glu Thr Asp Leu Thr
290 295 300

Met Asn Phe Glu Thr Ser Arg Ile Gly Lys Lys Val Ile Glu Phe Gln
305 310 315 320

Asp Val Ser Phe Ala Tyr Glu Asn Lys Pro Ile Leu Gln Asn Phe Asn
325 330 335

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Leu Leu Val Gln Ala Lys Asp Arg Ile Gly Ile Val Gly Asp Asn Gly
            340                 345                 350

Val Gly Lys Ser Thr Leu Leu Asn Leu Ile Ala Gly Ser Leu Glu Pro
        355                 360                 365

Thr Ala Gly Gln Val Val Ile Gly Glu Thr Val Arg Ile Ala Tyr Phe
    370                 375                 380

Ser Gln Gln Ile Glu Gly Leu Asp Glu Ser Lys Arg Val Ile Asn Tyr
385                 390                 395                 400

Leu Gln Glu Val Ala Glu Glu Val Lys Thr Ser Gly Gly Ser Thr Thr
                405                 410                 415

Ser Ile Ala Glu Leu Leu Glu Gln Phe Leu Phe Pro Arg Ser Thr His
            420                 425                 430

Gly Thr Leu Ile Glu Lys Leu Ser Gly Gly Glu Lys Lys Arg Leu Tyr
        435                 440                 445

Leu Leu Lys Leu Leu Leu Glu Lys Pro Asn Val Leu Leu Leu Asp Glu
    450                 455                 460

Pro Thr Asn Asp Leu Asp Ile Ala Thr Leu Thr Val Leu Glu Asn Phe
465                 470                 475                 480

Leu Gln Gly Phe Ala Gly Pro Val Leu Thr Val Ser His Asp Arg Tyr
                485                 490                 495

Phe Leu Asp Lys Val Ala Thr Lys Ile Leu Ala Phe Glu Asp Gly Lys
            500                 505                 510

Ile Arg Pro Phe Phe Gly His Tyr Thr Asp Tyr Leu Asp Glu Lys Ala
        515                 520                 525

Phe Glu Thr Asp Met Ala Asn Gln Val Gln Lys Ala Glu Lys Glu Lys
    530                 535                 540

Val Val Lys Val Arg Glu Asp Lys Lys Arg Met Thr Tyr Gln Glu Lys
545                 550                 555                 560
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Gln Glu Trp Ala Ser Ile Glu Gly Asp Ile Glu Thr Leu Glu Lys Arg
565 570 575

Ile Ala Ala Ile Glu Glu Glu Met Gln Ala Asn Gly Ser Asp Phe Gly
580 585 590

Lys Leu Ala Thr Leu Gln Lys Glu Leu Asp Glu Lys Asn Glu Ala Leu
595 600 605

Leu Glu Lys Tyr Glu Arg Tyr Glu Tyr Leu Ser Glu Phe Asp Ser
610 615 620

<210> 353
<211> 178
<212> PRT
<213> Streptococcus pneumoniae

<400> 353

Met Asn Glu Val Lys Lys Met Val Glu Leu Lys Lys Glu Ala Val Lys
1 5 10 15

Asp Val Thr Ser Leu Thr Lys Ala Ala Pro Val Ala Leu Ala Lys Thr
20 25 30

Lys Glu Val Leu Asn Gln Ala Val Ala Asp Leu Tyr Val Ala His Val
35 40 45

Ala Leu His Gln Val His Trp Tyr Met His Gly Arg Gly Phe Leu Val
50 55 60

Trp His Pro Lys Met Asp Glu Tyr Met Glu Ala Leu Asp Gly Gln Leu
65 70 75 80

Asp Glu Ile Ser Glu Arg Leu Ile Thr Leu Gly Gly Ser Pro Phe Ser
85 90 95

Thr Leu Thr Glu Phe Leu Gln Asn Ser Glu Ile Glu Glu Glu Ala Gly
100 105 110

Glu Tyr Arg Asn Val Glu Glu Ser Leu Glu Arg Val Leu Val Ile Tyr
115 120 125

Arg Tyr Leu Ser Glu Leu Phe Gln Lys Gly Leu Asp Val Thr Asp Glu
    130   135   140

Glu Gly Asp Asp Val Thr Asn Gly Ile Phe Ala Gly Ala Lys Thr Glu
145   150   155   160

Thr Asp Lys Thr Ile Trp Met Leu Ala Ala Glu Leu Gly Gln Ala Pro
                165   170   175

Gly Leu

<210> 354
<211> 356
<212> PRT
<213> Streptococcus pneumoniae

<400> 354

Met Phe Gly Leu Ile Gly Cys Ile Tyr Gly Ala Phe Gly Arg Lys Ile
1   5   10   15

Trp Ser Glu Ser His Gly Lys Ser Ile Cys Phe Ser Ile Arg Arg Trp
            20   25   30

Lys Tyr Leu Asn Arg Ile Cys Asn Arg Pro Ser Glu Leu Trp Leu Leu
        35   40   45

Tyr Leu Ala Tyr Gly Ile Leu Gly Gly Leu Gly Leu Gly Ala Gly Tyr
    50   55   60

Ile Thr Pro Val Ser Thr Ile Ile Lys Trp Phe Pro Asp Lys Arg Gly
65   70   75   80

Leu Ala Thr Gly Leu Ala Ile Met Gly Phe Gly Phe Ala Ser Leu Leu
                85   90   95

Thr Ser Pro Ile Ala Gln His Leu Ile Ala Gly Val Gly Leu Val Glu
            100   105   110

Thr Phe Tyr Ile Leu Gly Ala Ser Tyr Phe Ile Ile Met Leu Leu Ala
        115   120   125

Ser Gln Phe Ile Lys Arg Pro Asn Glu Gln Glu Leu Ala Ile Leu Ser
130 135 140

Ser Ser Gly Lys Glu Lys Thr Ala Ser Leu Thr Gln Gly Met Ala Ala
145 150 155 160

Asn Gln Ala Leu Lys Ser Asn Arg Phe Tyr Met Leu Trp Ile Ile Phe
165 170 175

Phe Ile Asn Ile Ala Cys Gly Leu Gly Leu Ile Ser Ala Ala Ser Pro
180 185 190

Met Ala Gln Glu Met Ala Gly Leu Ser Thr Ser His Ala Ala Val Met
195 200 205

Val Gly Val Leu Gly Ile Phe Asn Gly Phe Gly Arg Leu Leu Trp Ala
210 215 220

Ser Leu Ser Asp Tyr Ile Gly Arg Pro Leu Thr Phe Ser Ile Leu Leu
225 230 235 240

Leu Val Asn Leu Phe Phe Ser Leu Ser Leu Trp Leu Phe Thr Asp Ser
245 250 255

Val Leu Phe Val Val Ala Met Ser Ile Leu Met Thr Cys Tyr Gly Ala
260 265 270

Gly Phe Ser Leu Ile Pro Ala Tyr Leu Ser Asp Ile Phe Gly Thr Lys
275 280 285

Glu Leu Ala Ala Leu His Gly Tyr Ile Leu Thr Ala Trp Ala Met Ala
290 295 300

Gly Leu Ala Gly Pro Ile Leu Leu Ala Glu Thr Tyr Lys Met Ala His
305 310 315 320

Ser Tyr Thr Gln Thr Leu Phe Val Phe Leu Ile Leu Tyr Ser Ile Ala
325 330 335

Leu Ala Leu Ser Tyr Tyr Leu Gly Arg Ser Ile Lys Lys Glu Ser Gln
340 345 350

Lys Ala Leu Thr
355

<210> 355
<211> 153
<212> PRT
<213> Streptococcus pneumoniae

<400> 355

Met Lys Gln Thr Lys Thr Thr Lys Ile Ala Leu Val Ser Leu Leu Thr
1 5 10 15

Ala Leu Ser Val Val Leu Gly Tyr Phe Leu Lys Ile Pro Thr Pro Thr
20 25 30

Gly Ile Leu Thr Leu Leu Asp Ala Gly Val Phe Phe Ala Ala Phe Tyr
35 40 45

Phe Gly Ser Arg Glu Gly Ala Val Val Gly Gly Leu Ala Ser Phe Leu
50 55 60

Ile Asp Leu Leu Ser Gly Tyr Pro Gln Trp Met Phe Phe Ser Leu Val
65 70 75 80

Asn His Gly Leu Gln Gly Phe Phe Ala Gly Phe Lys Gly Lys Ser Gln
85 90 95

Trp Leu Gly Leu Ile Leu Ala Thr Ile Ala Met Val Gly Gly Tyr Ala
100 105 110

Leu Gly Ser Ala Leu Met Asn Gly Trp Ala Ala Ala Leu Pro Glu Ile
115 120 125

Leu Pro Asn Phe Met Gln Asn Met Val Gly Met Ile Val Gly Phe Ile
130 135 140

Leu Ser Gln Ser Ile Lys Lys Ile Lys
145 150

<210> 356
<211> 225

<212> PRT
<213> Streptococcus pneumoniae

<400> 356

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Met Ile Ser Lys Arg Leu Glu Leu Val Ala Ser Phe Val Ser Gln Gly
1               5                   10                  15

Ala Ile Leu Leu Asp Val Gly Ser Asp His Ala Tyr Leu Pro Ile Glu
            20                  25                  30

Leu Val Glu Arg Gly Gln Ile Lys Ser Ala Ile Ala Gly Glu Val Val
        35                  40                  45

Glu Gly Pro Tyr Gln Ser Ala Val Lys Asn Val Glu Ala His Gly Leu
    50                  55                  60

Lys Glu Lys Ile Gln Val Arg Leu Ala Asn Gly Leu Ala Ala Phe Glu
65                  70                  75                  80

Glu Thr Asp Gln Val Ser Val Ile Thr Ile Ala Gly Met Gly Gly Arg
                85                  90                  95

Leu Ile Ala Arg Ile Leu Glu Glu Gly Leu Gly Lys Leu Ala Asn Val
            100                 105                 110

Glu Arg Leu Ile Leu Gln Pro Asn Asn Arg Glu Asp Asp Leu Arg Ile
        115                 120                 125

Trp Leu Gln Asp His Gly Phe Gln Ile Val Ala Glu Ser Ile Leu Glu
    130                 135                 140

Glu Ala Gly Lys Phe Tyr Glu Ile Leu Val Val Glu Ala Gly Gln Met
145                 150                 155                 160

Lys Leu Ser Ala Ser Asp Val Arg Phe Gly Pro Phe Leu Ser Lys Glu
                165                 170                 175

Val Ser Pro Val Phe Val Gln Lys Trp Gln Lys Glu Ala Glu Lys Leu
            180                 185                 190

Glu Phe Ala Leu Gly Gln Ile Pro Glu Lys Asn Leu Glu Glu Arg Gln
        195                 200                 205
```

Val Leu Val Asp Lys Ile Gln Ala Ile Lys Glu Val Leu His Val Ser
    210   215   220

Lys
225

<210> 357
<211> 108
<212> PRT
<213> Streptococcus pneumoniae

<400> 357

Met Glu Gly Ile Arg Met Lys Ile Val Gly Val Ala Ala Cys Thr Val
1   5   10   15

Gly Ile Ala His Thr Tyr Ile Ala Gln Glu Lys Leu Glu Asn Ala Ala
            20   25   30

Lys Val Ala Gly His Val Ile His Val Glu Thr Gln Gly Thr Ile Gly
        35   40   45

Val Glu Asn Glu Leu Ser Gln Glu Gln Ile Asp Ala Ala Asp Val Val
    50   55   60

Ile Leu Ala Val Asp Val Lys Ile Ser Gly Met Glu Arg Phe Glu Gly
65   70   75   80

Lys Lys Ile Ile Lys Val Pro Thr Glu Val Ala Val Lys Ser Pro Asn
                85   90   95

Lys Leu Ile Ala Lys Ala Val Glu Ile Val Thr Lys
            100   105

<210> 358
<211> 240
<212> PRT
<213> Streptococcus pneumoniae

<400> 358

Met Ile Arg Ile Glu Asn Leu Ser Val Ser Tyr Lys Glu Thr Leu Ala
1   5   10   15

Leu Lys Asp Ile Ser Leu Val Leu His Gly Pro Thr Ile Thr Gly Ile
20 25 30

Ile Gly Pro Asn Gly Ala Gly Lys Ser Thr Leu Leu Lys Gly Met Leu
35 40 45

Gly Ile Ile Pro His Gln Gly Gln Ala Phe Leu Asp Asp Lys Glu Val
50 55 60

Lys Lys Ser Leu His Arg Ile Ala Tyr Val Glu Gln Lys Ile Asn Ile
65 70 75 80

Asp Tyr Asn Phe Pro Ile Lys Val Lys Glu Cys Val Ser Leu Gly Leu
85 90 95

Phe Pro Ser Ile Pro Leu Phe Arg Ser Leu Lys Ala Lys His Trp Lys
100 105 110

Lys Val Gln Glu Ala Leu Glu Ile Val Gly Leu Ala Asp Tyr Ala Glu
115 120 125

Arg Gln Ile Ser Gln Leu Ser Gly Gly Gln Phe Gln Arg Val Leu Ile
130 135 140

Ala Arg Cys Leu Val Gln Glu Ala Asp Tyr Ile Leu Leu Asp Glu Pro
145 150 155 160

Phe Ala Gly Ile Asp Ser Val Ser Glu Glu Ile Ile Met Asn Thr Leu
165 170 175

Arg Asp Leu Lys Lys Ala Gly Lys Thr Val Leu Ile Val His His Asp
180 185 190

Leu Ser Lys Ile Pro His Tyr Phe Asp Gln Val Leu Leu Val Asn Arg
195 200 205

Glu Val Ile Ala Phe Gly Pro Thr Lys Glu Thr Phe Thr Glu Thr Asn
210 215 220

Leu Lys Glu Ala Tyr Gly Asn Gln Leu Phe Phe Asn Gly Gly Asp Leu
225 230 235 240

<210> 359
<211> 294
<212> PRT
<213> Streptococcus pneumoniae

<400> 359

Met Thr Tyr Tyr Val Ala Ile Asp Ile Gly Gly Thr Asn Ile Lys Tyr
1 5 10 15

Gly Leu Val Asp Gln Glu Gly Gln Leu Leu Glu Ser His Glu Met Pro
20 25 30

Thr Glu Ala His Lys Gly Gly Pro His Ile Leu Gln Lys Thr Lys Asp
35 40 45

Ile Val Ala Ser Tyr Leu Glu Lys Gly Pro Val Ala Gly Val Ala Ile
50 55 60

Ser Ser Ala Gly Met Val Asp Pro Asp Lys Gly Glu Ile Phe Tyr Ala
65 70 75 80

Gly Pro Gln Ile Pro Asn Tyr Ala Gly Thr Gln Phe Lys Lys Glu Ile
85 90 95

Glu Glu Ser Phe Thr Ile Pro Cys Glu Ile Glu Asn Asp Val Asn Cys
100 105 110

Ala Gly Leu Ala Glu Ala Val Ser Gly Ser Gly Lys Gly Ala Ser Val
115 120 125

Thr Leu Cys Leu Thr Ile Gly Thr Gly Ile Gly Gly Cys Leu Ile Met
130 135 140

Asp Arg Lys Val Phe His Gly Phe Ser Asn Ser Ala Cys Glu Val Gly
145 150 155 160

Tyr Met His Met Gln Asp Gly Ala Phe Gln Asp Leu Ala Ser Thr Thr
165 170 175

Ala Leu Val Lys Tyr Val Ala Glu Ala His Gly Glu Asp Val Asp Gln
180 185 190

Trp Asn Gly Arg Arg Ile Phe Lys Glu Ala Thr Glu Gly Asn Lys Ile
195 200 205

Cys Met Glu Gly Ile Asp Arg Met Val Asp Tyr Leu Gly Lys Gly Leu
210 215 220

Ala Asn Ile Cys Tyr Val Ala Asn Pro Glu Val Val Ile Leu Gly Gly
225 230 235 240

Gly Ile Met Gly Gln Glu Ala Ile Leu Lys Pro Lys Ile Arg Thr Ala
245 250 255

Leu Lys Glu Ala Leu Val Pro Ser Leu Ala Glu Lys Thr Arg Leu Glu
260 265 270

Phe Ala His His Gln Asn Thr Ala Gly Met Leu Gly Ala Tyr Tyr His
275 280 285

Phe Lys Thr Lys Gln Ser
290

<210> 360
<211> 214
<212> PRT
<213> Streptococcus pneumoniae

<400> 360

Met Ala Gln Lys Gly Val Ser Leu Ile Lys Ala Ala Phe Asp Thr Asp
1 5 10 15

Asn Phe Leu Met Arg Phe Ser Glu Lys Val Leu Asp Ile Val Thr Ala
20 25 30

Asn Leu Leu Phe Val Val Ser Cys Leu Pro Ile Val Thr Ile Gly Val
35 40 45

Ala Lys Ile Ser Leu Tyr Glu Thr Met Phe Glu Val Lys Lys Ser Arg
50 55 60

Arg Val Pro Val Phe Lys Ile Tyr Leu Arg Ser Phe Lys Gln Asn Leu
65 70 75 80

Lys Leu Gly Leu Gln Leu Gly Leu Met Glu Leu Gly Ile Val Phe Leu
85 90 95

Thr Leu Ser Asp Leu Tyr Leu Phe Trp Gly Gln Thr Ala Leu Pro Phe
100 105 110

Gln Leu Leu Lys Ala Ile Cys Leu Gly Ile Leu Ile Phe Leu Thr Ile
115 120 125

Val Met Leu Ala Ser Tyr Pro Ile Ala Ala Arg Tyr Asp Leu Ser Trp
130 135 140

Lys Glu Ile Leu Gln Lys Gly Leu Met Leu Ala Ser Phe Asn Phe Pro
145 150 155 160

Trp Phe Phe Leu Met Leu Ala Ile Leu Val Leu Ile Val Met Val Leu
165 170 175

Tyr Leu Ser Ala Phe Ser Leu Leu Leu Gly Gly Ser Val Phe Leu Leu
180 185 190

Phe Gly Phe Gly Leu Leu Val Phe Ile Gln Thr Gly Leu Met Glu Lys
195 200 205

Ile Phe Ala Lys Tyr Gln
210

<210> 361
<211> 294
<212> PRT
<213> Streptococcus pneumoniae

<400> 361

Met Val Lys Glu Arg Asn Leu Thr Arg Trp Ile Phe Val Leu Pro Ala
1 5 10 15

Met Ile Ile Val Gly Leu Leu Phe Val Tyr Pro Phe Phe Ser Ser Ile
20 25 30

Phe Tyr Ser Phe Thr Asn Lys His Leu Ile Met Pro Asn Tyr Lys Phe
35 40 45

Val Gly Leu Ala Asn Tyr Lys Ala Val Leu Ser Asp Pro Asn Phe Phe
50 55 60

Asn Ala Phe Phe Asn Ser Ile Lys Trp Thr Val Phe Ser Leu Val Gly
65 70 75 80

Gln Val Leu Val Gly Phe Val Leu Ala Leu Ala Leu His Arg Val Arg
85 90 95

His Phe Lys Lys Leu Tyr Arg Thr Leu Leu Ile Val Pro Trp Ala Phe
100 105 110

Pro Thr Ile Val Ile Ala Phe Ser Trp Gln Trp Ile Leu Asn Gly Val
115 120 125

Tyr Gly Tyr Leu Pro Asn Leu Ile Val Lys Leu Gly Leu Met Glu His
130 135 140

Thr Pro Ala Phe Leu Thr Asp Ser Thr Trp Ala Phe Leu Cys Leu Val
145 150 155 160

Phe Ile Asn Ile Trp Phe Gly Ala Pro Met Ile Met Val Asn Val Leu
165 170 175

Ser Ala Leu Gln Thr Val Pro Glu Glu Gln Phe Glu Ala Ala Lys Ile
180 185 190

Asp Gly Ala Ser Ser Trp Gln Val Phe Lys Phe Ile Val Phe Pro His
195 200 205

Ile Lys Val Val Val Gly Leu Leu Val Val Leu Arg Thr Val Trp Ile
210 215 220

Phe Asn Asn Phe Asp Ile Ile Tyr Leu Ile Thr Gly Gly Gly Pro Ala
225 230 235 240

Asn Ala Thr Thr Thr Leu Pro Ile Phe Ala Tyr Asn Leu Gly Trp Gly
245 250 255

Thr Lys Leu Leu Gly Arg Ala Ser Ala Val Thr Val Leu Leu Phe Ile

260 265 270

Phe Leu Val Ala Ile Cys Phe Ile Tyr Phe Ala Ile Ile Ser Lys Trp
275 280 285

Glu Lys Glu Gly Arg Lys
290

<210> 362
<211> 445
<212> PRT
<213> Streptococcus pneumoniae

<400> 362

Met Lys Lys Met Arg Lys Phe Leu Cys Leu Ala Gly Ile Ala Leu Ala
1 5 10 15

Ala Val Ala Leu Val Ala Cys Ser Gly Lys Lys Glu Ala Thr Thr Ser
20 25 30

Thr Glu Pro Pro Thr Glu Leu Ser Gly Glu Ile Thr Met Trp His Ser
35 40 45

Phe Thr Gln Gly Pro Arg Leu Glu Ser Ile Gln Lys Ser Ala Asp Ala
50 55 60

Phe Met Gln Lys His Pro Lys Thr Lys Ile Lys Ile Glu Thr Phe Ser
65 70 75 80

Trp Asn Asp Phe Tyr Thr Lys Trp Thr Thr Gly Leu Ala Asn Gly Asn
85 90 95

Val Pro Asp Ile Ser Thr Ala Leu Pro Asn Gln Val Met Glu Met Val
100 105 110

Asn Ser Asp Ala Leu Val Pro Leu Asn Asp Ser Ile Lys Arg Ile Gly
115 120 125

Gln Asp Lys Phe Asn Glu Thr Ala Leu Asn Glu Ala Lys Ile Gly Asp
130 135 140

Asp Tyr Tyr Ser Val Pro Leu Tyr Ser His Ala Gln Val Met Trp Val

145 150 155 160

Arg Thr Asp Leu Leu Lys Glu His Asn Ile Glu Val Pro Lys Thr Trp
165 170 175

Asp Gln Leu Tyr Glu Ala Ser Lys Lys Leu Lys Glu Ala Gly Val Tyr
180 185 190

Gly Leu Ser Val Pro Phe Gly Thr Asn Asp Leu Met Ala Thr Arg Phe
195 200 205

Leu Asn Phe Tyr Val Arg Ser Gly Gly Gly Ser Leu Leu Thr Lys Asp
210 215 220

Leu Lys Ala Asp Leu Thr Ser Gln Leu Ala Gln Asp Gly Ile Lys Tyr
225 230 235 240

Trp Val Lys Leu Tyr Lys Glu Ile Ser Pro Gln Asp Ser Leu Asn Phe
245 250 255

Asn Val Leu Gln Gln Ala Thr Leu Phe Tyr Gln Gly Lys Thr Ala Phe
260 265 270

Asp Phe Asn Ser Gly Phe His Ile Gly Gly Ile Asn Ala Asn Ser Pro
275 280 285

Gln Leu Ile Asp Ser Ile Asp Ala Tyr Pro Ile Pro Lys Ile Lys Glu
290 295 300

Ser Asp Lys Asp Gln Gly Ile Glu Thr Ser Asn Ile Pro Met Val Val
305 310 315 320

Trp Lys Asn Ser Lys His Pro Glu Val Ala Lys Ala Phe Leu Glu Ala
325 330 335

Leu Tyr Asn Glu Glu Asp Tyr Val Lys Phe Leu Asp Ser Thr Pro Val
340 345 350

Gly Met Leu Pro Thr Ile Lys Gly Ile Ser Asp Ser Ala Ala Tyr Lys
355 360 365

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Glu Asn Glu Thr Arg Lys Lys Phe Lys His Ala Glu Glu Val Ile Thr
    370                 375                 380

Glu Ala Val Lys Lys Gly Thr Ala Ile Gly Tyr Glu Asn Gly Pro Ser
385                 390                 395                 400

Val Gln Ala Gly Met Leu Thr Asn Gln His Ile Ile Glu Gln Met Phe
                405                 410                 415

Gln Asp Ile Ile Thr Asn Gly Thr Asp Pro Met Lys Ala Ala Lys Glu
            420                 425                 430

Ala Glu Lys Gln Leu Asn Asp Leu Phe Glu Ala Val Gln
        435                 440                 445


<210>  363
<211>  800
<212>  PRT
<213>  Streptococcus pneumoniae

<400>  363

Met Ser Tyr Phe Arg Asn Arg Asp Ile Asp Ile Glu Arg Ile Ser Met
1               5                   10                  15

Asn Arg Ser Val Gln Glu Arg Lys Cys Arg Tyr Ser Ile Arg Lys Leu
            20                  25                  30

Ser Val Gly Ala Val Ser Met Ile Val Gly Ala Val Val Phe Gly Thr
        35                  40                  45

Ser Pro Val Leu Ala Gln Glu Gly Ala Ser Glu Gln Pro Leu Ala Asn
    50                  55                  60

Glu Thr Gln Leu Ser Gly Glu Ser Ser Thr Leu Thr Asp Thr Glu Lys
65                  70                  75                  80

Ser Gln Pro Ser Ser Glu Thr Glu Leu Ser Gly Asn Lys Gln Glu Gln
                85                  90                  95

Glu Arg Lys Asp Lys Gln Glu Glu Lys Ile Pro Arg Asp Tyr Tyr Ala
            100                 105                 110
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Arg Asp Leu Glu Asn Val Glu Thr Val Ile Glu Lys Glu Asp Val Glu
        115                 120                 125

Thr Asn Ala Ser Asn Gly Gln Arg Val Asp Leu Ser Ser Glu Leu Asp
    130                 135                 140

Lys Leu Lys Lys Leu Glu Asn Ala Thr Val His Met Glu Phe Lys Pro
145                 150                 155                 160

Asp Ala Lys Ala Pro Ala Phe Tyr Asn Leu Phe Ser Val Ser Ser Ala
                165                 170                 175

Thr Lys Lys Asp Glu Tyr Phe Thr Met Ala Val Tyr Asn Asn Thr Ala
            180                 185                 190

Thr Leu Glu Gly Arg Gly Ser Asp Gly Lys Gln Phe Tyr Asn Asn Tyr
        195                 200                 205

Asn Asp Ala Pro Leu Lys Val Lys Pro Gly Gln Trp Asn Ser Val Thr
    210                 215                 220

Phe Thr Val Glu Lys Pro Thr Ala Glu Leu Pro Lys Gly Arg Val Arg
225                 230                 235                 240

Leu Tyr Val Asn Gly Val Leu Ser Arg Thr Ser Leu Arg Ser Gly Asn
                245                 250                 255

Phe Ile Lys Asp Met Pro Asp Val Thr His Val Gln Ile Gly Ala Thr
            260                 265                 270

Lys Arg Ala Asn Asn Thr Val Trp Gly Ser Asn Leu Gln Ile Arg Asn
        275                 280                 285

Leu Thr Val Tyr Asn Arg Ala Leu Thr Pro Glu Glu Val Gln Lys Arg
    290                 295                 300

Ser Gln Leu Phe Lys Arg Ser Asp Leu Glu Lys Lys Leu Pro Glu Gly
305                 310                 315                 320

Ala Ala Leu Thr Glu Lys Thr Asp Ile Phe Glu Ser Gly Arg Asn Gly
                325                 330                 335
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Asn Pro Asn Lys Asp Gly Ile Lys Ser Tyr Arg Ile Pro Ala Leu Leu
340 345 350

Lys Thr Asp Lys Gly Thr Leu Ile Ala Gly Ala Asp Glu Arg Arg Leu
355 360 365

His Ser Ser Asp Trp Gly Asp Ile Gly Met Val Ile Arg Arg Ser Glu
370 375 380

Asp Asn Gly Lys Thr Trp Gly Asp Arg Val Thr Ile Thr Asn Leu Arg
385 390 395 400

Asp Asn Pro Lys Ala Ser Asp Pro Ser Ile Gly Ser Pro Val Asn Ile
405 410 415

Asp Met Val Leu Val Gln Asp Pro Glu Thr Lys Arg Ile Phe Ser Ile
420 425 430

Tyr Asp Met Phe Pro Glu Gly Lys Gly Ile Phe Gly Met Ser Ser Gln
435 440 445

Lys Glu Glu Ala Tyr Lys Lys Ile Asp Gly Lys Thr Tyr Gln Ile Leu
450 455 460

Tyr Arg Glu Gly Glu Lys Gly Ala Tyr Thr Ile Arg Glu Asn Gly Thr
465 470 475 480

Val Tyr Thr Pro Asp Gly Lys Ala Thr Asp Tyr Arg Val Val Val Asp
485 490 495

Pro Val Lys Pro Ala Tyr Ser Asp Lys Gly Asp Leu Tyr Lys Gly Asp
500 505 510

Gln Leu Leu Gly Asn Ile Tyr Phe Thr Thr Asn Lys Thr Ser Pro Phe
515 520 525

Arg Ile Ala Lys Asp Ser Tyr Leu Trp Met Ser Tyr Ser Asp Asp Asp
530 535 540

Gly Lys Thr Trp Ser Ala Pro Gln Asp Ile Thr Pro Met Val Lys Ala
545 550 555 560

Asp Trp Met Lys Phe Leu Gly Val Gly Pro Gly Thr Gly Ile Val Leu
565 570 575

Arg Asn Gly Pro His Lys Gly Arg Ile Leu Ile Pro Val Tyr Thr Thr
580 585 590

Asn Asn Val Ser His Leu Asp Gly Ser Gln Ser Ser Arg Val Ile Tyr
595 600 605

Ser Asp Asp His Gly Lys Thr Trp His Ala Gly Glu Ala Val Asn Asp
610 615 620

Asn Arg Gln Val Asp Gly Gln Lys Ile His Ser Ser Thr Met Asn Asn
625 630 635 640

Arg Arg Ala Gln Asn Thr Glu Ser Thr Val Val Gln Leu Asn Asn Gly
645 650 655

Asp Val Lys Leu Phe Met Arg Gly Leu Thr Gly Asp Leu Gln Val Ala
660 665 670

Thr Ser Lys Asp Gly Gly Val Thr Trp Glu Lys Asp Ile Lys Arg Tyr
675 680 685

Pro Gln Val Lys Asp Val Tyr Val Gln Met Ser Ala Ile His Thr Met
690 695 700

His Glu Gly Lys Glu Tyr Ile Ile Leu Ser Asn Ala Gly Gly Pro Lys
705 710 715 720

Arg Glu Asn Gly Met Val His Leu Ala Arg Val Glu Glu Asn Gly Glu
725 730 735

Leu Thr Trp Leu Lys His Asn Pro Ile Gln Lys Gly Glu Phe Ala Tyr
740 745 750

Asn Ser Leu Gln Glu Leu Gly Asn Gly Glu Tyr Gly Ile Leu Tyr Glu
755 760 765

His Thr Glu Lys Gly Gln Asn Ala Tyr Thr Leu Ser Phe Arg Lys Phe

770 775 780

Asn Trp Glu Phe Leu Ser Lys Asn Leu Ile Ser Pro Thr Glu Ala Asn
785 790 795 800

<210> 364
<211> 210
<212> PRT
<213> Streptococcus pneumoniae

<400> 364

Met Arg Leu Glu Ile Ile Asn Gly Gln Lys Ile Tyr Gly Lys Arg Pro
1 5 10 15

Ile Leu Asn Gln Leu Asn Leu Val Phe Gln Ser Gly Lys Ile Tyr Gly
20 25 30

Leu Lys Gly Asp Asn Gly Ser Gly Lys Thr Val Leu Leu Lys Ile Leu
35 40 45

Ala Gly Tyr Ile Lys Leu Asp Lys Gly Lys Val Leu Gln Asp Gly Lys
50 55 60

Val Tyr Gly Val Lys Asn His Tyr Ile Gln Asp Ala Gly Ile Leu Ile
65 70 75 80

Glu Lys Val Glu Phe Leu Ser His Leu Ser Leu Arg Glu Asn Leu Glu
85 90 95

Leu Leu Arg Tyr Phe Ser Ser Lys Val Thr Glu Lys Arg Ile Ala Tyr
100 105 110

Trp Ile Gln Tyr Tyr Asp Leu Gln Glu Phe Glu Asp Ile Glu Tyr Arg
115 120 125

His Leu Ser Leu Gly Thr Lys Gln Lys Met Ala Leu Ile Gln Ala Phe
130 135 140

Ile Ser Ser Pro Ser Ile Leu Phe Leu Asp Glu Pro Met Asn Ala Leu
145 150 155 160

Asp Glu Lys Ser Val Arg Leu Thr Lys Gln Val Ile Leu Ser Tyr Leu

165 170 175

Lys Lys Glu Asn Gly Leu Val Ile Leu Thr Ser His Ile Ser Glu Asp
180 185 190

Ile Ser Asp Leu Cys Thr Asp Val Leu Val Val Glu Asn Gly His Ile
195 200 205

Gln Met
210

<210> 365
<211> 97
<212> PRT
<213> Streptococcus pneumoniae

<400> 365

Met Arg Ser Met Thr Arg Leu Ala Ser Gln Val Ser Ser Phe Pro Cys
1 5 10 15

Phe Thr Phe Ala Lys Cys Phe Ser Lys Ser Ser Lys Leu Lys Leu Asp
20 25 30

Val Lys Lys Val Gly Lys Phe Ser Cys Ile Arg Tyr Trp Arg Met Thr
35 40 45

Cys Arg Ile Ser Ser Arg Thr Gln Thr Val Asp Cys Ser Ala Pro Ile
50 55 60

Ser Ser Lys Ile Arg Thr Ser Asp Ser Leu Ile Ser Ser Thr Lys Val
65 70 75 80

Leu Thr Leu Pro Ser Leu Ile Ala Phe Leu Thr Ser Met Thr Lys Leu
85 90 95

Gly

<210> 366
<211> 501
<212> PRT
<213> Streptococcus pneumoniae

<400> 366

Met Ile Ile Leu Lys Glu Phe Lys Pro Met Ser Leu Leu Val Phe Glu
1 5 10 15

Asn Val Ser Lys Ser Tyr Gly Ala Thr Pro Ala Leu Glu Asn Val Ser
20 25 30

Leu Asp Ile Pro Ala Gly Lys Ile Val Gly Leu Leu Gly Pro Asn Gly
35 40 45

Ser Gly Lys Thr Thr Leu Ile Lys Leu Ile Asn Gly Leu Leu Gln Pro
50 55 60

Asp Gln Gly Arg Val Leu Ile Asn Asp Met Asp Pro Ser Pro Ala Thr
65 70 75 80

Lys Ala Val Val Ala Tyr Leu Pro Asp Thr Thr Tyr Leu Asn Glu Gln
85 90 95

Met Lys Val Lys Glu Ala Leu Thr Tyr Phe Lys Thr Phe Tyr Lys Asp
100 105 110

Phe Asn Leu Glu Arg Ala His His Leu Leu Ala Asp Leu Gly Ile Asp
115 120 125

Glu Asn Ser Arg Leu Lys Lys Leu Ser Lys Glu Asn Lys Glu Lys Val
130 135 140

Gln Leu Ile Leu Val Met Ser Arg Asp Ala Arg Leu Tyr Val Leu Asp
145 150 155 160

Glu Pro Ile Gly Gly Val Asp Pro Ala Ala Arg Ala Tyr Ile Leu Asn
165 170 175

Thr Ile Ile Asn Asn Tyr Ser Pro Thr Ser Thr Val Leu Ile Ser Thr
180 185 190

His Leu Ile Ser Asp Ile Glu Pro Ile Leu Asp Glu Ile Val Phe Leu
195 200 205

Lys Asp Gly Lys Val Val Arg Gln Gly Asn Val Asp Asp Ile Arg Tyr

210 215 220

Glu Ser Gly Glu Ser Ile Asp Gln Leu Phe Arg Gln Asn Leu Arg Pro
225 230 235 240

Lys Gln Arg Arg Leu Phe Met Phe Trp Asn Leu Val Arg Tyr Glu Phe
245 250 255

Lys Asn Val Asn Lys Trp Tyr Leu Ala Leu Tyr Ala Ala Val Leu Val
260 265 270

Leu Ser Ala Leu Ile Gly Ile Gln Thr Gln Gly Phe Lys Asn Leu Pro
275 280 285

Tyr Gln Glu Ser Gln Ala Thr Met Leu Leu Phe Leu Ala Thr Val Phe
290 295 300

Gly Gly Leu Met Leu Thr Leu Gly Ile Ser Thr Ile Phe Leu Ile Ile
305 310 315 320

Lys Arg Phe Lys Gly Ser Val Tyr Asp Arg Gln Gly Tyr Leu Thr Leu
325 330 335

Thr Leu Pro Val Ser Glu His His Ile Ile Thr Ala Lys Leu Ile Gly
340 345 350

Ala Phe Ile Trp Ser Leu Ile Ser Thr Ala Val Leu Ala Leu Ser Ala
355 360 365

Val Ile Ile Leu Ala Leu Thr Ala Pro Glu Trp Ile Pro Leu Ser Tyr
370 375 380

Val Ile Thr Phe Val Glu Thr His Leu Pro Gln Ile Phe Leu Thr Gly
385 390 395 400

Ile Ser Phe Leu Leu Asn Thr Ile Ser Gly Ile Leu Cys Ile Tyr Leu
405 410 415

Ala Ile Ser Ile Gly Gln Leu Phe Asn Glu Tyr Arg Thr Ala Leu Ala
420 425 430

Val Ala Val Tyr Ile Gly Ile Gln Ile Val Ile Gly Phe Ile Glu Leu
435 440 445

Phe Phe Asn Leu Ser Ser Asn Phe Tyr Val Asn Ser Leu Val Gly Leu
450 455 460

Asn Asp His Phe Tyr Met Gly Ala Gly Ile Ala Ile Val Glu Glu Leu
465 470 475 480

Ile Phe Ile Ala Ile Phe Tyr Leu Gly Thr Tyr Tyr Ile Leu Arg Asn
485 490 495

Lys Val Asn Leu Leu
500

<210> 367
<211> 381
<212> PRT
<213> Streptococcus pneumoniae

<400> 367

Met Val Thr Pro Phe Val Thr Leu Leu Val Met Ser Ile Leu Gly Leu
1 5 10 15

Phe Val Ile Gly Pro Val Phe His Val Val Glu Asn Tyr Ile Leu Ile
20 25 30

Ala Thr Lys Ala Ile Leu Ser Met Pro Phe Gly Leu Gly Gly Phe Leu
35 40 45

Ile Gly Gly Val His Gln Leu Ile Val Val Ser Gly Val His His Ile
50 55 60

Phe Asn Leu Leu Glu Val Gln Leu Leu Ala Ala Asp His Ala Asn Pro
65 70 75 80

Phe Asn Ala Ile Ile Thr Ala Ala Met Thr Ala Gln Gly Ala Ala Thr
85 90 95

Val Ala Val Gly Val Lys Thr Lys Asn Pro Lys Leu Lys Thr Leu Ala
100 105 110

Phe Pro Ala Ala Leu Ser Ala Phe Leu Gly Ile Thr Glu Pro Ala Ile
115 120 125

Phe Gly Val Asn Leu Arg Phe Arg Lys Pro Phe Phe Leu Ser Leu Ile
130 135 140

Ala Gly Ala Ile Gly Gly Gly Leu Ala Ser Ile Leu Gly Leu Ala Gly
145 150 155 160

Thr Gly Asn Gly Ile Thr Ile Ile Pro Gly Thr Met Leu Tyr Val Gly
165 170 175

Asn Gly Gln Leu Pro Gln Tyr Leu Leu Met Val Ala Val Ser Phe Ala
180 185 190

Leu Gly Phe Ala Leu Thr Tyr Met Phe Gly Tyr Glu Asp Glu Val Asp
195 200 205

Ala Thr Ala Ala Ala Lys Arg Ala Glu Val Ala Glu Glu Lys Glu Glu
210 215 220

Val Ala Pro Ala Ala Leu Gln Asn Glu Thr Leu Val Thr Pro Ile Val
225 230 235 240

Gly Asp Val Val Ala Leu Ala Asp Val Asn Asp Pro Val Phe Ser Ser
245 250 255

Gly Ala Met Gly Gln Gly Ile Val Val Lys Pro Ser Gln Gly Val Val
260 265 270

Tyr Ala Pro Ala Asp Ala Glu Val Ser Ile Ala Phe Pro Thr Gly His
275 280 285

Ala Phe Gly Leu Lys Thr Arg Asn Gly Ala Glu Val Leu Ile His Val
290 295 300

Gly Ile Asp Thr Val Ser Met Asn Gly Asp Gly Phe Glu Thr Lys Val
305 310 315 320

Ala Gln Gly Asn Lys Val Lys Ala Gly Asp Val Leu Gly Thr Phe Asp
325 330 335

Ser Asn Lys Ile Ala Ala Ala Gly Leu Asp Asp Thr Thr Met Val Ile
340 345 350

Val Thr Asn Thr Gly Asp Tyr Ala Ser Val Ala Pro Val Ala Thr Gly
355 360 365

Ser Val Ala Lys Gly Asp Ala Val Ile Glu Val Lys Ile
370 375 380

<210> 368
<211> 249
<212> PRT
<213> Streptococcus pneumoniae

<400> 368

Met Gln Met Asn Asn Gln Glu Ile Ala Lys Lys Val Ile Asp Ala Leu
1 5 10 15

Gly Gly Arg Glu Asn Val Asn Ser Val Ala His Cys Ala Thr Arg Leu
20 25 30

Arg Val Met Val Lys Asp Glu Glu Lys Ile Asn Lys Glu Val Ile Glu
35 40 45

Asn Leu Glu Lys Val Gln Gly Ala Phe Phe Asn Ser Gly Gln Tyr Gln
50 55 60

Ile Ile Phe Gly Thr Gly Thr Val Asn Lys Met Tyr Asp Glu Val Val
65 70 75 80

Val Leu Gly Leu Pro Thr Ser Ser Lys Asp Asp Met Lys Ala Glu Val
85 90 95

Ala Lys Gln Gly Asn Trp Phe Gln Arg Ala Ile Arg Thr Phe Gly Asp
100 105 110

Val Phe Val Pro Ile Ile Pro Val Ile Val Ala Thr Gly Leu Phe Met
115 120 125

Gly Val Arg Gly Leu Phe Asn Ala Leu Glu Met Pro Leu Pro Gly Asp
130 135 140

Phe Ala Thr Tyr Thr Gln Ile Leu Thr Asp Thr Ala Phe Ile Ile Leu
145 150 155 160

Pro Gly Leu Val Val Trp Ser Thr Phe Arg Val Phe Gly Gly Asn Pro
165 170 175

Ala Val Gly Ile Val Leu Gly Met Met Leu Val Ser Gly Ser Leu Pro
180 185 190

Asn Ala Trp Ala Val Ala Gln Gly Gly Glu Val Thr Ala Met Asn Phe
195 200 205

Phe Gly Phe Ile Pro Val Val Gly Leu Gln Gly Ser Val Leu Pro Ala
210 215 220

Phe Ile Ile Gly Val Val Gly Ala Lys Phe Glu Lys Ala Val Arg Lys
225 230 235 240

Leu Phe Gln Met Ser Leu Thr Ser Trp
245

<210> 369
<211> 201
<212> PRT
<213> Streptococcus pneumoniae

<400> 369

Met Arg Leu Met Lys Ile Trp Tyr Asn Glu Ile Lys Glu Phe Tyr Met
1 5 10 15

Gln Lys Phe Ile Gln Ala Tyr Ile Glu Lys Leu Asp Val Thr Thr Ile
20 25 30

Ile Glu Asn Ile Leu Thr Lys Val Ile Ser Leu Leu Leu Leu Leu Ile
35 40 45

Val Phe Tyr Ile Ala Lys Lys Met Leu His Thr Met Val Gln Arg Ile
50 55 60

Val Lys Pro Ser Leu Lys Met Ser Arg His Asp Val Gly Arg Gln Lys
65 70 75 80

Thr Ile Ser Arg Leu Leu Glu Asn Val Phe Asn Tyr Thr Leu Tyr Phe
85 90 95

Phe Leu Leu Tyr Cys Ile Leu Ser Ile Leu Gly Leu Pro Val Ser Ser
100 105 110

Leu Leu Ala Gly Ala Gly Ile Ala Gly Val Ala Ile Gly Met Gly Ala
115 120 125

Gln Gly Phe Leu Ser Asp Val Ile Asn Gly Phe Phe Ile Leu Phe Glu
130 135 140

Arg Gln Leu Asp Val Gly Asp Glu Val Val Leu Thr Asn Gly Pro Ile
145 150 155 160

Thr Val Ser Gly Lys Val Val Ser Val Gly Ile Arg Thr Thr Gln Leu
165 170 175

Arg Ser Glu Glu Gln Ala Leu His Phe Val Pro Asn Arg Asn Ile Thr
180 185 190

Val Val Ser Asn Phe Ser Arg Thr Asp
195 200

<210> 370
<211> 598
<212> PRT
<213> Streptococcus pneumoniae

<400> 370

Met Glu Gln Lys His Arg Ser Glu Phe Pro Glu Lys Glu Leu Trp Asp
1 5 10 15

Leu Thr Ala Leu Tyr Gln Asp Arg Glu Asp Phe Leu Arg Ala Ile Glu
20 25 30

Lys Ala Arg Glu Asp Ile Asn Gln Phe Ser Arg Asp Tyr Lys Gly Asn
35 40 45

Leu His Thr Phe Glu Asp Phe Glu Lys Ala Phe Ala Glu Leu Glu Gln
50 55 60

Ile Tyr Ile Gln Met Ser His Ile Gly Asn Tyr Gly Phe Met Pro Gln
65 70 75 80

Thr Thr Asp Tyr Ser Asn Asp Glu Phe Ala Asn Ile Ala Gln Ala Gly
85 90 95

Met Glu Phe Glu Thr Asp Ala Ser Val Ala Leu Thr Phe Phe Asp Asp
100 105 110

Ala Leu Val Ala Ala Asp Glu Glu Val Leu Asp Arg Leu Gly Lys Leu
115 120 125

Pro His Leu Thr Ala Ala Ile Arg Gln Ala Lys Ile Lys Lys Ala His
130 135 140

Tyr Leu Gly Ala Asp Val Glu Lys Ala Leu Thr Asn Leu Gly Glu Val
145 150 155 160

Phe Tyr Ser Pro Gln Asp Ile Tyr Thr Lys Met Arg Ala Gly Asp Phe
165 170 175

Glu Met Ala Asp Phe Glu Ala His Gly Lys Thr Tyr Lys Asn Ser Phe
180 185 190

Val Thr Tyr Glu Asn Phe Tyr Gln Asn His Glu Asp Ala Glu Val Arg
195 200 205

Glu Lys Ser Phe Arg Ser Phe Ser Glu Gly Leu Arg Lys His Gln Asn
210 215 220

Thr Ala Ala Ala Ala Tyr Leu Ala Gln Val Lys Ser Glu Lys Leu Leu
225 230 235 240

Ala Asp Met Lys Gly Tyr Asp Ser Val Phe Asp Tyr Leu Leu Ala Glu
245 250 255

Gln Glu Val Asp Arg Val Met Phe Asp Arg Gln Ile Asp Leu Ile Met
260 265 270

Lys Asp Phe Ala Pro Val Ala Gln Arg Tyr Leu Lys His Val Ala Lys
275 280 285

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Val Asn Gly Leu Glu Lys Met Thr Phe Ala Asp Trp Lys Leu Asp Leu
    290                 295                 300

Asp Ser Ala Leu Asn Pro Glu Val Thr Ile Asp Asp Ala Tyr Asp Leu
305                     310                 315                 320

Val Met Lys Ser Val Glu Pro Leu Gly Gln Glu Tyr Cys Gln Glu Val
                325                 330                 335

Ala Arg Tyr Gln Glu Glu Arg Trp Val Asp Phe Ala Ala Asn Ser Gly
            340                 345                 350

Lys Asp Ser Gly Gly Tyr Ala Ala Asp Pro Tyr Arg Val His Pro Tyr
        355                 360                 365

Val Leu Met Ser Trp Thr Gly Arg Leu Ser Asp Val Tyr Thr Leu Ile
    370                 375                 380

His Glu Ile Gly His Ser Gly Gln Phe Ile Phe Ser Asp Asn His Gln
385                     390                 395                 400

Ser Tyr Phe Asn Ala His Met Ser Thr Tyr Tyr Val Glu Ala Pro Ser
                405                 410                 415

Thr Phe Asn Glu Leu Leu Leu Ser Asp Tyr Leu Glu Asn Gln Ser Asn
            420                 425                 430

Asp Pro Arg Gln Lys Arg Phe Ala Leu Ala His Arg Leu Thr Asp Thr
        435                 440                 445

Tyr Phe His Asn Phe Ile Thr His Leu Leu Glu Ala Ala Phe Gln Arg
    450                 455                 460

Lys Val Tyr Thr Leu Ile Glu Glu Gly Glu Thr Phe Gly Ala Ser Lys
465                     470                 475                 480

Leu Asn Ser Ile Met Lys Glu Val Leu Thr Asp Phe Trp Gly Asp Ala
                485                 490                 495

Ile Glu Ile Asp Asp Asp Ala Thr Leu Thr Trp Met Arg Gln Ala His
```

500 505 510

Tyr Tyr Met Gly Leu Tyr Ser Tyr Thr Tyr Ser Ala Gly Leu Val Ile
515 520 525

Ser Thr Ala Gly Tyr Leu His Leu Lys His Ser Glu Thr Gly Ala Glu
530 535 540

Asp Trp Leu Asn Leu Leu Lys Ser Gly Gly Ser Lys Thr Pro Leu Glu
545 550 555 560

Ser Ala Met Ile Ile Gly Ala Asp Ile Ser Thr Asp Lys Pro Leu Arg
565 570 575

Asp Thr Ile Gln Phe Leu Ser Asp Thr Val Asp Gln Ile Ile Ser Tyr
580 585 590

Ser Ala Glu Leu Gly Glu
595

<210> 371
<211> 190
<212> PRT
<213> Streptococcus pneumoniae

<400> 371

Met Tyr Met Ser Lys Ala Lys Lys Ile Cys Phe Ile Ile Phe Cys Ile
1 5 10 15

Leu Ile Leu Thr Ile Phe Leu Pro Val Leu Ile Asp Tyr His Gln Val
20 25 30

Ser Asp Leu Gly Ile His Leu Leu Ser Trp Arg Gln Asn Ser Val Val
35 40 45

Glu Phe Tyr Leu Ala Arg Tyr Val Phe Trp Gly Thr Val Val Leu Ser
50 55 60

Thr Leu Val Leu Leu Ser Ile Leu Val Val Met Phe Tyr Pro Lys Arg
65 70 75 80

Tyr Leu Glu Ile Gln Leu Glu Thr Lys Asn Asp Thr Leu Lys Leu Lys

85 90 95

Asn Ser Ala Ile Glu Gly Phe Val Arg Ser Leu Val Ser Asp His Arg
100 105 110

Leu Ile Lys Asn Pro Thr Val His Val Asn Leu Arg Lys Asn Lys Cys
115 120 125

Phe Val His Val Glu Gly Lys Ile Leu Pro Ser Asp Asn Ile Ala Asp
130 135 140

Arg Cys Gln Ile Ile Gln Asn Glu Ile Thr Asn Gly Leu Lys Gln Phe
145 150 155 160

Phe Gly Ile Glu Arg Gln Val Lys Leu Glu Val Ala Val Lys Asn Tyr
165 170 175

Gln Pro Lys Pro Gln Asn Lys Lys Thr Val Ser Arg Val Lys
180 185 190

<210> 372
<211> 219
<212> PRT
<213> Streptococcus pneumoniae

<400> 372

Met Ile Asp Phe Tyr Phe Phe Leu Val Gly Ser Ile Leu Ala Ser Phe
1 5 10 15

Leu Gly Leu Val Ile Asp Arg Phe Pro Glu Gln Ser Ile Ile Ser Ser
20 25 30

Ala Ser His Cys Asp Ser Cys Gln Thr Pro Leu Arg Pro Leu Asp Leu
35 40 45

Ile Pro Ile Leu Ser Gln Val Phe Asn Arg Phe Arg Cys Arg Tyr Cys
50 55 60

Lys Val Arg Tyr Pro Val Trp Tyr Ala Leu Phe Glu Leu Ser Leu Gly
65 70 75 80

Leu Leu Phe Leu Leu Tyr Ser Trp Gly Trp Leu Ser Leu Gly Gln Val

85 90 95

Val Leu Ile Thr Ala Gly Leu Thr Leu Gly Ile Tyr Asp Phe His His
100 105 110

Gln Glu Tyr Pro Leu Leu Val Trp Met Thr Phe Gln Leu Ile Leu Ile
115 120 125

Ala Ser Ser Gly Trp Asn Leu Val Met Val Ser Phe Leu Ile Leu Gly
130 135 140

Ile Leu Ala His Phe Ile Asp Ile Arg Met Gly Ala Gly Asp Phe Leu
145 150 155 160

Phe Leu Ala Ser Cys Ala Leu Val Phe Ser Val Thr Glu Leu Leu Ile
165 170 175

Leu Ile Gln Phe Ala Ser Ala Thr Gly Ile Leu Ala Phe Leu Leu Gln
180 185 190

Lys Lys Lys Glu Arg Leu Pro Phe Val Pro Phe Leu Leu Leu Ala Thr
195 200 205

Cys Leu Ile Ile Phe Gly Lys Leu Leu Leu Val
210 215

<210> 373
<211> 383
<212> PRT
<213> Streptococcus pneumoniae

<400> 373

Met Phe Asn Gly Arg Val Leu Lys Glu Leu Arg Leu Leu Asn Gly Leu
1 5 10 15

Ser Arg Ala Glu Leu Ala Gln Arg Ile Asn Leu Thr Glu Gln Ala Ile
20 25 30

Trp Gln Phe Glu Ser Asn Glu Thr Lys Pro Lys Leu Ser Thr Lys Met
35 40 45

His Leu Ala Asn Gln Phe His Val Asp Leu Thr Tyr Phe Glu Gln Glu

50 55 60

Glu Glu Ser Ile Arg Phe Asp Ser Ser Val Ile Ala Phe Arg Asn Ala
65 70 75 80

Asp Leu Ala Thr Arg Lys Thr Ile Asp Ile Gln Thr Met Tyr Leu His
85 90 95

Lys Val Asp Ser Leu Ile Asp Tyr Phe Glu Ser Phe Val Ile Ile Pro
100 105 110

Asn Ile Ile Ile His Asp Leu Ser Asn Val Val Ser Glu Ser Tyr His
115 120 125

Lys Gly Glu Ser Ile Glu Glu Leu Ala Leu Tyr Ala Arg Glu Lys Leu
130 135 140

Gly Ile Ser Lys Asp Asn His Asp Leu Leu Tyr Lys Leu Glu Arg Ser
145 150 155 160

Gly Ile Tyr Ile Val Glu Arg Leu Ile Asn Gly Gln Ala Asp Ala Tyr
165 170 175

Ser Ala Trp Ser Lys Leu Gly Arg Pro Tyr Ile Val Leu Gly Thr Asn
180 185 190

Lys Ser Ser Val Arg Arg Asn Phe Asp Leu Ala His Glu Leu Gly His
195 200 205

Ile Leu Leu His Lys Tyr Lys Asp Met Asn Glu Asp Gly Asp Arg Leu
210 215 220

Glu Gln Glu Ala Asn Tyr Phe Ala Ser Cys Phe Leu Leu Pro Lys Glu
225 230 235 240

Glu Phe Leu Val Lys Phe Glu Glu Arg Val Gly Lys Arg Val Ser Asn
245 250 255

Pro Asp Ser Tyr Ile Leu Leu Lys Ser Asp Leu Asn Val Ser Ile Gln
260 265 270

Ala Leu Glu Tyr Arg Ala Phe Lys Leu Gly Leu Leu Thr Pro Lys Gln
275 280 285

His Ser Tyr Phe Tyr Arg Gln Ile Ala Gln Lys Gly Tyr Lys Met Ile
290 295 300

Glu Pro Leu Asp Asp Gln Ile Phe Val Lys Lys Pro Ser Lys Val Lys
305 310 315 320

Ser Ile Leu Asp Val Val Leu Ser Asn His Leu Val Ser Leu Ala Thr
325 330 335

Ile Met Ser Lys Gln Ser Ile Arg Leu Gln Phe Ile Ser Glu Ile Phe
340 345 350

Ser Val Glu Met Lys Phe Phe Asp Gln Tyr Gln Glu Asp Arg Arg Thr
355 360 365

Asp Arg Phe Asp Asn Ile Ile Pro Leu Tyr Lys Arg Asn Asn Leu
370 375 380

<210> 374
<211> 594
<212> PRT
<213> Streptococcus pneumoniae

<400> 374

Met Ala Ser Gly Phe His Leu Gln Ser Glu Arg Asp Phe Met Ser Ile
1 5 10 15

Ile Gln Lys Leu Trp Trp Phe Phe Lys Leu Glu Lys Arg Arg Tyr Leu
20 25 30

Val Gly Ile Val Ala Leu Ile Leu Val Ser Val Leu Asn Leu Ile Pro
35 40 45

Pro Met Val Met Gly Arg Val Ile Asp Ala Ile Thr Ser Gly Gln Leu
50 55 60

Thr Gln Gln Asp Leu Leu Leu Ser Leu Phe Tyr Leu Leu Leu Ala Ala
65 70 75 80

Phe Gly Met Tyr Tyr Leu Arg Tyr Val Trp Arg Met Tyr Ile Leu Gly
85 90 95

Thr Ser Tyr Cys Leu Gly Gln Ile Met Arg Ser Arg Leu Phe Lys His
100 105 110

Phe Thr Lys Met Ser Ser Ala Phe Tyr Gln Thr Tyr Arg Thr Gly Asp
115 120 125

Leu Met Ala His Ala Thr Asn Asp Ile Asn Ala Leu Thr Arg Leu Ala
130 135 140

Gly Gly Gly Val Met Ser Ala Val Asp Ala Ser Ile Thr Ala Leu Val
145 150 155 160

Thr Leu Leu Thr Met Leu Phe Ser Ile Ser Trp Gln Met Thr Leu Val
165 170 175

Ala Ile Leu Pro Leu Pro Phe Met Ala Tyr Thr Thr Ser Arg Leu Gly
180 185 190

Arg Lys Thr His Lys Ala Phe Gly Glu Ser Gln Ala Ala Phe Ser Glu
195 200 205

Leu Asn Asn Lys Val Gln Glu Ser Val Ser Gly Ile Lys Val Thr Lys
210 215 220

Ser Phe Gly Tyr Gln Ala Asp Glu Leu Lys Ser Phe Gln Ala Val Asn
225 230 235 240

Glu Leu Thr Phe Gln Lys Asn Leu Gln Thr Met Lys Tyr Asp Ser Leu
245 250 255

Phe Asp Pro Met Val Leu Leu Phe Val Gly Ser Ser Tyr Val Leu Thr
260 265 270

Leu Leu Val Gly Ser Leu Met Val Gln Glu Gly Gln Ile Thr Val Gly
275 280 285

Asn Leu Val Thr Phe Ile Ser Tyr Leu Asp Met Leu Val Trp Pro Leu
290 295 300

Leu Ala Ile Gly Phe Leu Phe Asn Thr Thr Gln Arg Gly Lys Val Ser
305 310 315 320

Tyr Gln Arg Ile Glu Asn Leu Leu Ser Gln Glu Ser Pro Val Gln Asp
325 330 335

Pro Glu Phe Pro Leu Asp Gly Ile Glu Asn Gly Arg Leu Glu Tyr Ala
340 345 350

Ile Asp Ser Phe Ala Phe Glu Asn Glu Glu Thr Leu Thr Asp Ile His
355 360 365

Phe Ser Leu Ala Lys Gly Gln Thr Leu Gly Leu Val Gly Gln Thr Gly
370 375 380

Ser Gly Lys Thr Ser Leu Ile Lys Leu Leu Leu Arg Glu Tyr Asp Val
385 390 395 400

Asp Lys Gly Ala Ile Tyr Leu Asn Gly His Asp Ile Arg Asp Tyr Arg
405 410 415

Leu Thr Asp Leu Arg Ser Leu Met Gly Tyr Val Pro Gln Asp Gln Phe
420 425 430

Leu Phe Ala Thr Ser Ile Leu Asp Asn Ile Arg Phe Gly Asn Pro Asn
435 440 445

Leu Pro Leu Ser Ala Val Glu Glu Ala Thr Lys Leu Ala Arg Val Tyr
450 455 460

Gln Asp Ile Val Asp Met Pro Gln Gly Phe Asp Thr Leu Ile Gly Glu
465 470 475 480

Lys Gly Val Ser Leu Ser Gly Gly Gln Lys Gln Arg Leu Ala Met Ser
485 490 495

Arg Ala Met Ile Leu Asp Pro Asp Ile Leu Ile Leu Asp Asp Ser Leu
500 505 510

Ser Ala Val Asp Ala Lys Thr Glu Tyr Ala Ile Ile Asp Asn Leu Lys
515 520 525

Glu Met Arg Lys Asp Lys Thr Thr Ile Ile Thr Ala His Arg Leu Ser
530 535 540

Ala Val Val His Ala Asp Phe Ile Leu Val Leu Gln Asn Gly Gln Ile
545 550 555 560

Ile Glu Arg Gly Thr His Glu Asp Leu Leu Ala Leu Asp Gly Trp Tyr
565 570 575

Ala Gln Thr Tyr Gln Ser Gln Gln Leu Glu Met Lys Gly Glu Glu Asp
580 585 590

Ala Glu

<210> 375
<211> 655
<212> PRT
<213> Streptococcus pneumoniae

<400> 375

Met Gly Lys Phe Glu Gln Glu Ala Lys Asp Leu Leu Gln Ala Ile Gly
1 5 10 15

Gly Lys Glu Asn Val Thr Ala Val Thr His Cys Ala Thr Arg Met Arg
20 25 30

Phe Val Leu Gly Asp Asp Lys Lys Ala Asn Val Lys Ala Ile Glu Ser
35 40 45

Ile Pro Ala Val Lys Gly Thr Phe Thr Asn Ala Gly Gln Phe Gln Val
50 55 60

Ile Ile Gly Asn Asp Val Pro Ile Phe Tyr Asn Asp Phe Thr Ala Val
65 70 75 80

Ser Gly Ile Glu Gly Val Ser Lys Glu Ala Ala Lys Ser Ala Ala Lys
85 90 95

Ser Asn Gln Asn Val Val Gln Gly Val Met Thr Thr Leu Ala Glu Ile
100 105 110

Phe Thr Pro Ile Ile Pro Ala Leu Ile Val Gly Gly Leu Ile Leu Gly
115 120 125

Phe Arg Asn Val Leu Glu Gly Val His Trp Ser Met Leu Asp Gly Lys
130 135 140

Thr Ile Thr Glu Ser Ser Gln Phe Trp Ala Gly Val Asn His Phe Leu
145 150 155 160

Trp Leu Pro Gly Glu Ala Ile Phe Gln Phe Leu Pro Val Gly Ile Thr
165 170 175

Trp Ser Val Ser Arg Lys Met Gly Thr Ser Gln Ile Leu Gly Ile Val
180 185 190

Leu Gly Ile Cys Leu Val Ser Pro Gln Leu Leu Asn Ala Tyr Ala Val
195 200 205

Ala Ser Thr Pro Ala Ala Asp Ile Ala Ala Asn Trp Val Trp Asn Phe
210 215 220

Gly Tyr Phe Thr Val Asn Arg Ile Gly Tyr Gln Ala Gln Val Ile Pro
225 230 235 240

Ala Leu Leu Ala Gly Leu Ser Leu Ser Tyr Leu Glu Ile Phe Trp His
245 250 255

Lys His Ile Pro Glu Val Ile Ser Met Ile Phe Val Pro Phe Leu Ser
260 265 270

Leu Ile Pro Ala Leu Ile Leu Ala His Thr Val Leu Gly Pro Ile Gly
275 280 285

Trp Thr Ile Gly Gln Gly Leu Ser Ser Val Val Leu Ala Gly Leu Thr
290 295 300

Gly Pro Val Lys Trp Leu Phe Gly Ala Ile Phe Gly Ala Leu Tyr Ala
305 310 315 320

Pro Phe Val Ile Thr Gly Leu His His Met Thr Asn Ala Ile Asp Thr

325 330 335

Gln Leu Ile Ala Asp Ala Gly Gly Thr Ala Leu Trp Pro Met Ile Ala
340 345 350

Leu Ser Asn Ile Ala Gln Gly Ser Ala Val Phe Ala Tyr Tyr Phe Met
355 360 365

His Arg His Asp Glu Arg Glu Ala Gln Val Ser Leu Pro Ala Thr Ile
370 375 380

Ser Ala Tyr Leu Gly Val Thr Glu Pro Ala Leu Phe Gly Val Asn Val
385 390 395 400

Lys Tyr Ile Tyr Pro Phe Val Ala Gly Met Thr Gly Ser Ala Leu Ala
405 410 415

Gly Met Leu Ser Val Thr Phe Asn Val Thr Ala Ala Ser Ile Gly Ile
420 425 430

Gly Gly Leu Pro Gly Ile Leu Ser Ile Gln Pro Gln Tyr Met Leu Pro
435 440 445

Phe Ala Gly Thr Met Leu Val Ala Ile Val Val Pro Met Leu Leu Thr
450 455 460

Phe Phe Phe Arg Lys Ala Gly Leu Phe Thr Lys Thr Glu Gly Asp Thr
465 470 475 480

Asn Leu Gln Ala Glu Phe Val Ala Gln Glu Glu Ala Glu Phe Val Asn
485 490 495

His Glu Pro Val Glu Leu Thr Ser Val Glu Ile Ile Ser Pro Leu Thr
500 505 510

Gly Gln Val Lys Glu Leu Ser Gln Ala Thr Asp Pro Ile Phe Ala Ser
515 520 525

Gly Val Met Gly Gln Gly Leu Val Ile Glu Pro Ser Gln Gly Glu Leu
530 535 540

Thr Ser Pro Val Asn Gly Thr Val Thr Val Leu Phe Pro Thr Lys His
545 550 555 560

Ala Ile Gly Ile Val Ser Asp Glu Gly Val Glu Leu Leu Ile His Ile
565 570 575

Gly Met Asp Thr Val Gly Leu Asp Gly Lys Gly Phe Glu Ser Leu Val
580 585 590

Val Gln Gly Asp His Val Thr Val Gly Gln Gln Leu Ile Arg Phe Asp
595 600 605

Met Asp Val Ile Lys Ala Ala Gly Leu Val Thr Glu Thr Pro Val Ile
610 615 620

Ile Thr Asn Gln Asp Ala Tyr Thr Ala Thr Ile Pro Gly Thr Tyr Pro
625 630 635 640

Thr Thr Ile Gln Ala Gly Ala Ser Leu Met Val Ala Thr Arg Ile
645 650 655

<210> 376
<211> 175
<212> PRT
<213> Streptococcus pneumoniae

<400> 376

Met Ser Arg Val His Val Gln Ile Met Asn Gln Phe His Arg Lys Ser
1 5 10 15

His Glu Tyr Lys Ala Ile Lys Arg Tyr Trp Lys Leu Ile Gln Gln Asp
20 25 30

Ser Arg Lys Leu Ser Asp Lys Arg Phe Tyr Arg Pro Thr Phe Arg Met
35 40 45

His Leu Thr Asn Lys Glu Ile Leu Asp Lys Ile Leu Ser Tyr Ser Glu
50 55 60

Asp Leu Lys His His Tyr Gln Ile Tyr Gln Leu Leu Leu Phe His Phe
65 70 75 80

Gln Asn Lys Asp Pro Glu Lys Phe Phe Gly Leu Ile Glu Asp Asn Leu
85 90 95

Lys Gln Val His Pro Leu Phe Gln Thr Val Phe Lys Thr Phe Leu Lys
100 105 110

Asp Lys Glu Lys Ile Ile Asn Ala Leu Gln Leu His Tyr Ser Asn Ala
115 120 125

Lys Leu Glu Ala Thr Asn Asn Leu Ile Lys Leu Ile Lys Arg Asn Ala
130 135 140

Phe Gly Phe Arg Asn Phe Glu Asn Phe Lys Lys Arg Ile Phe Ile Ala
145 150 155 160

Leu Asn Ile Lys Lys Glu Arg Thr Lys Phe Val Leu Ser Arg Ala
165 170 175

<210> 377
<211> 355
<212> PRT
<213> Streptococcus pneumoniae

<400> 377

Met Thr Lys Glu Lys Asn Val Ile Leu Thr Ala Arg Asp Ile Val Val
1 5 10 15

Glu Phe Asp Val Arg Asp Lys Val Leu Thr Ala Ile Arg Gly Val Ser
20 25 30

Leu Glu Leu Val Glu Gly Glu Val Leu Ala Leu Val Gly Glu Ser Gly
35 40 45

Ser Gly Lys Ser Val Leu Thr Lys Thr Phe Thr Gly Met Leu Glu Glu
50 55 60

Asn Gly Arg Ile Ala Gln Gly Ser Ile Asp Tyr Arg Gly Gln Asp Leu
65 70 75 80

Thr Ala Leu Ser Ser His Lys Asp Trp Glu Gln Ile Arg Gly Ala Lys
85 90 95

Ile Ala Thr Ile Phe Gln Asp Pro Met Thr Ser Leu Asp Pro Ile Lys
            100   105   110

Thr Ile Gly Ser Gln Ile Thr Glu Val Ile Val Lys His Gln Gly Lys
        115   120   125

Thr Ala Lys Glu Ala Lys Glu Leu Ala Ile Asp Tyr Met Asn Lys Val
    130   135   140

Gly Ile Pro Asp Ala Asp Arg Arg Phe Asn Glu Tyr Pro Phe Gln Tyr
145   150   155   160

Ser Gly Gly Met Arg Gln Arg Ile Val Ile Ala Ile Ala Leu Ala Cys
                165   170   175

Arg Pro Asp Val Leu Ile Cys Asp Glu Pro Thr Thr Ala Leu Asp Val
            180   185   190

Thr Ile Gln Ala Gln Ile Ile Asp Leu Leu Lys Ser Leu Gln Asn Glu
        195   200   205

Tyr His Phe Thr Thr Ile Phe Ile Thr His Asp Leu Gly Val Val Ala
    210   215   220

Ser Ile Ala Asp Lys Val Ala Val Met Tyr Ala Gly Glu Ile Val Glu
225   230   235   240

Tyr Gly Thr Val Glu Glu Val Phe Tyr Asp Pro Arg His Pro Tyr Thr
                245   250   255

Trp Ser Leu Leu Ser Ser Leu Pro Gln Leu Ala Asp Asp Lys Gly Asp
            260   265   270

Leu Tyr Ser Ile Pro Gly Thr Pro Pro Ser Leu Tyr Thr Asp Leu Lys
        275   280   285

Gly Asp Ala Phe Ala Leu Arg Ser Asp Tyr Ala Met Gln Ile Asp Phe
    290   295   300

Glu Gln Lys Ala Pro Gln Phe Ser Val Ser Glu Thr His Trp Ala Lys
305   310   315   320

Thr Trp Leu Leu His Glu Asp Ala Pro Lys Val Glu Lys Pro Ala Val
325 330 335

Ile Ala Asn Leu His Asp Lys Ile Arg Glu Lys Met Gly Phe Ala His
340 345 350

Leu Ala Asp
355

<210> 378
<211> 308
<212> PRT
<213> Streptococcus pneumoniae

<400> 378

Met Ser Thr Ile Asp Lys Glu Lys Phe Gln Phe Val Lys Arg Asp Asp
1 5 10 15

Phe Ala Ser Glu Thr Ile Asp Ala Pro Ala Tyr Ser Tyr Trp Lys Ser
20 25 30

Val Phe Lys Gln Phe Met Lys Lys Lys Ser Thr Val Val Met Leu Gly
35 40 45

Ile Leu Val Ala Ile Ile Leu Ile Ser Phe Ile Tyr Pro Met Phe Ser
50 55 60

Lys Phe Asp Phe Asn Asp Val Ser Lys Val Asn Asp Phe Ser Val Arg
65 70 75 80

Tyr Ile Lys Pro Asn Ala Glu His Trp Phe Gly Thr Asp Ser Asn Gly
85 90 95

Lys Ser Leu Phe Asp Gly Val Trp Phe Gly Ala Arg Asn Ser Ile Leu
100 105 110

Ile Ser Val Ile Ala Thr Val Ile Asn Leu Val Ile Gly Val Phe Val
115 120 125

Gly Gly Ile Trp Gly Ile Ser Lys Ser Val Asp Arg Val Met Met Glu
130 135 140

Val Tyr Asn Val Ile Ser Asn Ile Pro Pro Leu Leu Ile Val Ile Val
145 150 155 160

Leu Thr Tyr Ser Ile Gly Ala Gly Phe Trp Asn Leu Ile Phe Ala Met
165 170 175

Ser Val Thr Thr Trp Ile Gly Ile Ala Phe Met Ile Arg Val Gln Ile
180 185 190

Leu Arg Tyr Arg Asp Leu Glu Tyr Asn Leu Ala Ser Arg Thr Leu Gly
195 200 205

Thr Pro Thr Leu Lys Ile Val Ala Lys Asn Ile Met Pro Gln Leu Val
210 215 220

Ser Val Ile Val Thr Thr Met Thr Gln Met Leu Pro Ser Phe Ile Ser
225 230 235 240

Tyr Glu Ala Phe Leu Ser Phe Phe Gly Leu Gly Leu Pro Ile Thr Val
245 250 255

Pro Ser Leu Gly Arg Leu Ile Ser Asp Tyr Ser Gln Asn Val Thr Thr
260 265 270

Asn Ala Tyr Leu Phe Trp Ile Pro Leu Thr Thr Leu Val Leu Val Ser
275 280 285

Leu Ser Leu Phe Val Val Gly Gln Asn Leu Ala Asp Ala Ser Asp Pro
290 295 300

Arg Thr His Arg
305

<210> 379
<211> 498
<212> PRT
<213> Streptococcus pneumoniae

<400> 379

Met Lys Lys Tyr Ile Phe Met Arg Val Leu Arg Ser Leu Val Ser Ile
1 5 10 15

```
Phe Leu Val Thr Thr Leu Thr Tyr Thr Ile Ile Tyr Thr Leu Val Pro
            20                  25                  30

Arg Lys Leu Ile Phe Lys Gln Asp Pro Asn Tyr Asn Lys Ile Ala Thr
        35                  40                  45

Thr Ala Asp Lys Arg Asp Asn Tyr Glu Asn Thr Val Phe Glu Arg Met
    50                  55                  60

Gly Tyr Ile Glu Tyr Tyr Asp Thr Lys Glu Leu Gln Glu Lys Ala Ser
65                  70                  75                  80

Ser Met Asp Ser Ser Val Thr Val Glu Ala Asn Ala Thr Asn Lys Ala
                85                  90                  95

Ile Tyr Glu Lys Tyr Ile Asn Gln Leu Gly His Gly Trp Thr Leu Gly
            100                 105                 110

Glu Phe Thr Glu Ser Gly Gln Phe Tyr Ala Thr Arg Glu Ile Pro Ile
        115                 120                 125

Phe Glu Arg Val Phe His Phe Tyr Ala Asn Leu Ile Asp Ile Asp His
    130                 135                 140

Thr Asn Lys Ile Gln Asp Pro Glu Asn Pro Asp Leu Lys Arg Tyr Leu
145                 150                 155                 160

Arg Phe Glu Asn Asp Pro Ala Ile Gly Trp Ser Leu Val Gly Ser Gly
                165                 170                 175

Thr Lys His Lys Tyr Leu Leu Tyr Phe Asn Ser Gln Phe Pro Phe Val
            180                 185                 190

His Gln Asn Phe Val Asn Leu Asn Leu Gly Asp Ser Tyr Pro Thr Tyr
        195                 200                 205

Ala Asn Thr Pro Val Leu Gln Val Ile Thr Gln Gly Gln Gly Gln Thr
    210                 215                 220

Lys Thr Ala Gln Val Gln Phe Pro Thr Gly Lys Lys Thr Ser Ser Val
225                 230                 235                 240
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Asn Ile Tyr Ser Arg Thr Tyr Lys Ser Pro Ser Gln Ala Asp Ser Arg
245 250 255

Glu Val Ala Ser Tyr Gly Lys Asp Asp Pro Tyr Thr Ala Thr Glu Ser
260 265 270

Asn Tyr Gln Tyr Pro Ser Met Ile Val Ser Ser Ala Ile Thr Gly Leu
275 280 285

Ile Gly Leu Val Leu Ala Tyr Ala Leu Ala Val Pro Leu Gly Ser Ala
290 295 300

Met Ala Arg Phe Lys Asn Thr Trp Ile Asp Ser Leu Ser Thr Gly Ala
305 310 315 320

Leu Thr Phe Leu Leu Ala Leu Pro Thr Ile Ala Leu Val Tyr Ile Val
325 330 335

Arg Leu Ile Gly Ser Ser Ile Ala Leu Pro Asp Ser Phe Pro Ile Leu
340 345 350

Gly Ala Gly Asp Trp Arg Ser Tyr Val Leu Pro Ala Val Ile Leu Gly
355 360 365

Leu Leu Gly Ala Pro Gly Thr Ala Ile Trp Ile Arg Arg Tyr Met Ile
370 375 380

Asp Leu Gln Ser Gln Asp Phe Val Arg Phe Ala Arg Ala Lys Gly Leu
385 390 395 400

Ser Glu Lys Glu Ile Ser Asn Lys His Ile Phe Lys Asn Ala Met Val
405 410 415

Pro Leu Val Ser Gly Ile Pro Ala Ala Ile Ile Gly Val Ile Gly Gly
420 425 430

Ala Thr Leu Thr Glu Thr Val Phe Ala Phe Pro Gly Met Gly Lys Met
435 440 445

Leu Ile Asp Ser Val Lys Ala Ser Asn Asn Ser Met Val Val Gly Leu

450 455 460

Val Phe Ile Phe Thr Cys Ile Ser Ile Phe Ser Arg Leu Leu Gly Asp
465 470 475 480

Ile Trp Met Thr Ile Ile Asp Pro Arg Ile Lys Leu Thr Glu Lys Gly
485 490 495

Gly Lys

<210> 380
<211> 343
<212> PRT
<213> Streptococcus pneumoniae

<400> 380

Met Gly Phe Leu Leu Met Gly Ala Leu Phe Ile Val Leu Pro Arg Thr
1 5 10 15

Met Val Ser Ala Lys Arg Ile Asn Gln Val Leu Asp Leu His Ser Ser
20 25 30

Ile Gln Asn Pro Val Gln Val Gln Leu Thr Asp Glu Asn Phe Lys Gly
35 40 45

Gln Val Glu Phe Lys Asp Val Thr Phe Arg Tyr Ala Ala Asn Ser Glu
50 55 60

Ala Val Ile Glu His Val Ser Phe Lys Ala Glu Thr Gly Gln Thr Val
65 70 75 80

Ala Phe Ile Gly Ser Thr Gly Ser Gly Lys Ser Thr Leu Val Asn Leu
85 90 95

Ile Pro Arg Phe Tyr Asp Val Ser Ala Gly Glu Ile Leu Val Asp Gly
100 105 110

Val Asn Val Gln Asp Tyr Asp Phe Ser Ala Thr Ala His Ala Gly Gln
115 120 125

Lys Val Ala Ile Val Gly Pro Thr Gly Ala Gly Lys Thr Thr Ile Val

130 135 140

Asn Leu Leu Met Lys Phe Tyr Glu Ile Asp Lys Gly Ser Ile Arg Ile
145 150 155 160

Asp Gly Val Asp Thr Lys Ala Met Thr Arg Ser Glu Val His Asp Ala
165 170 175

Phe Ser Met Val Leu Gln Asp Thr Trp Leu Phe Glu Gly Thr Ile Arg
180 185 190

Asp Asn Leu Ile Tyr Asn Gln Ile Gly Ile Ser Asp Glu Arg Met Met
195 200 205

Glu Ala Ser Lys Ala Val Gly Ile His His Phe Ile Met Thr Leu Pro
210 215 220

Asp Gly Tyr Asp Thr Ile Leu Asp Asp Thr Val Thr Leu Ser Val Arg
225 230 235 240

Gln Lys Gln Leu Leu Thr Ile Ala Arg Ala Leu Leu Lys Asp Ala Pro
245 250 255

Leu Leu Ile Leu Asp Glu Ala Thr Ser Ser Val Asp Thr Arg Thr Glu
260 265 270

Glu Leu Ile Gln Lys Ala Met Asp Arg Leu Met Glu Gly Arg Thr Ser
275 280 285

Phe Val Ile Ala His Arg Leu Ser Thr Ile Arg Asn Ala Asp Leu Ile
290 295 300

Leu Val Met Lys Asp Gly Asn Ile Ile Glu Gln Gly Asn Tyr Glu Glu
305 310 315 320

Leu Met Ala Gln Gly Gly Phe Tyr Ala Asp Leu Tyr Asn Ser Gln Phe
325 330 335

Thr Glu Asp Glu Ala Glu Glu
340

<210> 381
<211> 273
<212> PRT
<213> Streptococcus pneumoniae

<400> 381

Met Ile Leu Leu Ala Ile Leu Phe Thr Cys Phe Ser Val Tyr Leu Glu
1 5 10 15

Leu Glu Val Pro Thr Tyr Ile Ser Lys Ile Thr Asp Leu Leu Gly Ser
20 25 30

Gln Glu Thr Asn Leu Asp Glu Leu Trp Gln Ser Ala Ser Met Met Met
35 40 45

Gly Met Ser Phe Leu Ala Phe Leu Ser Val Val Ala Val Gly Phe Phe
50 55 60

Ala Ser Arg Val Ala Ala Ser Tyr Thr Ser Arg Leu Arg Ser Asp Ile
65 70 75 80

Phe Asn Arg Val Leu Asp Tyr Ser Gln Thr Glu Ile Lys Lys Phe Ser
85 90 95

Ile Pro Ser Leu Leu Thr Arg Thr Thr Asn Asp Ile Thr Gln Val Gln
100 105 110

Met Leu Ile Thr Met Gly Leu Gln Val Val Thr Arg Gly Ser Ile Met
115 120 125

Ala Ile Trp Ala Ile Gly Lys Ile Leu Gly His Ser Glu Tyr Trp Leu
130 135 140

Trp Ala Val Leu Val Ala Val Ile Ile Asn Val Leu Met Thr Thr Val
145 150 155 160

Leu Met Thr Leu Ala Phe Pro Lys Gln Ser Leu Ile Gln Gly Leu Thr
165 170 175

Asp Lys Leu Asn Ser Ile Thr Arg Glu Ser Leu Thr Gly Ile Arg Val
180 185 190

Val Arg Ala Tyr Asn Ala Glu Asp Tyr Gln Asn Glu Lys Phe Ala Ala
195 200 205

Val Asn Asp Glu Leu Thr Arg Leu Asn Leu Phe Val Asn Arg Leu Met
210 215 220

Ala Ile Leu Asn Pro Ile Met Met Gly Ile Ser Ser Gly Leu Ser Val
225 230 235 240

Ala Ile Tyr Trp Ile Gly Ala Tyr Val Ile Asn Asp Ala Ala Pro Ile
245 250 255

Ala Arg Leu Pro Leu Phe Ser Asp Met Ile Val Phe Met Ser Tyr Ala
260 265 270

Met

<210> 382
<211> 456
<212> PRT
<213> Streptococcus pneumoniae

<400> 382

Met Asn Lys Lys Arg Thr Val Asp Leu Ile His Gly Pro Ile Leu Pro
1 5 10 15

Ser Leu Leu Ser Phe Thr Phe Pro Ile Leu Leu Ser Asn Ile Phe Gln
20 25 30

Gln Leu Tyr Asn Thr Ala Asp Val Leu Ile Val Gly Arg Phe Leu Gly
35 40 45

Gln Glu Ser Leu Ala Ala Val Gly Ala Thr Thr Ala Ile Phe Asp Leu
50 55 60

Ile Val Gly Phe Thr Leu Gly Val Gly Asn Gly Met Gly Ile Val Ile
65 70 75 80

Ala Arg Tyr Tyr Gly Ala Arg Asn Phe Thr Lys Ile Lys Glu Ala Val
85 90 95

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Ala Ala Thr Trp Ile Leu Gly Ala Leu Leu Ser Ile Leu Val Met Leu
            100                 105                 110

Leu Gly Phe Leu Gly Leu Tyr Pro Leu Leu Gln Tyr Leu Asp Thr Pro
        115                 120                 125

Ala Glu Ile Leu Pro Gln Ser Tyr Gln Tyr Ile Ser Met Ile Val Thr
    130                 135                 140

Cys Val Gly Val Ser Phe Ala Tyr Asn Leu Phe Ala Gly Leu Leu Arg
145                 150                 155                 160

Ser Ile Gly Asp Ser Leu Ala Ala Leu Gly Phe Leu Ile Phe Ser Ala
                165                 170                 175

Leu Val Asn Val Val Leu Asp Leu Tyr Phe Ile Thr Gln Leu His Leu
            180                 185                 190

Gly Val Gln Ser Ala Gly Leu Ala Thr Ile Ile Ser Gln Gly Leu Ser
        195                 200                 205

Ala Val Leu Cys Phe Tyr Tyr Ile Arg Lys Ser Val Pro Glu Leu Leu
    210                 215                 220

Pro Gln Phe Lys His Phe Lys Trp Asp Lys Ser Leu Tyr Ala Asp Leu
225                 230                 235                 240

Leu Glu Gln Gly Leu Ala Met Gly Leu Met Ser Ser Ile Val Ser Ile
                245                 250                 255

Gly Ser Val Ile Leu Gln Phe Ser Val Asn Thr Phe Gly Ala Val Ile
            260                 265                 270

Ile Ser Ala Gln Thr Ala Ala Arg Arg Ile Met Thr Phe Ala Leu Leu
        275                 280                 285

Pro Met Thr Ala Ile Ser Ala Ser Met Thr Thr Phe Ala Ser Gln Asn
    290                 295                 300

Leu Gly Ala Lys Arg Pro Asp Arg Ile Val Gln Gly Leu Arg Ile Gly
305                 310                 315                 320
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Ser Arg Leu Ser Ile Ser Trp Ala Val Phe Val Cys Ile Phe Leu Phe
325 330 335

Phe Ala Ser Pro Ala Leu Val Ser Phe Leu Ala Ser Ser Thr Asp Gly
340 345 350

Tyr Leu Ile Glu Asn Gly Ser Leu Tyr Leu Gln Ile Ser Ser Thr Phe
355 360 365

Tyr Pro Ile Leu Ser Leu Leu Leu Ile Tyr Arg Asn Cys Leu Gln Gly
370 375 380

Leu Gly Gln Lys Ile Leu Pro Leu Val Ser Ser Phe Ile Glu Leu Ile
385 390 395 400

Gly Lys Ile Val Phe Val Val Leu Ile Ile Pro Trp Ala Gly Tyr Lys
405 410 415

Gly Val Ile Leu Cys Glu Pro Leu Ile Trp Val Ala Met Thr Val Gln
420 425 430

Leu Tyr Phe Ser Leu Phe Arg His Pro Leu Ile Lys Glu Gly Lys Ala
435 440 445

Ile Leu Ala Thr Lys Val Gln Ser
450 455

<210> 383
<211> 206
<212> PRT
<213> Streptococcus pneumoniae

<400> 383

Met Lys Ser Met Arg Ile Leu Phe Leu Leu Ala Leu Ile Gln Ile Ser
1 5 10 15

Leu Ser Ser Cys Phe Leu Trp Lys Glu Cys Ile Leu Ser Phe Lys Gln
20 25 30

Ser Thr Ala Phe Phe Ile Gly Ser Met Val Phe Val Ser Gly Ile Cys
35 40 45

Ala Gly Val Asn Tyr Leu Tyr Thr Arg Lys Gln Glu Val His Ser Val
50 55 60

Leu Ala Ser Lys Lys Ser Val Lys Leu Phe Tyr Ser Met Leu Leu Leu
65 70 75 80

Ile Asn Leu Leu Gly Ala Val Leu Val Leu Ser Asp Asn Leu Phe Ile
85 90 95

Lys Asn Thr Leu Gln Gln Glu Leu Val Asp Phe Leu Leu Pro Ser Phe
100 105 110

Phe Phe Leu Phe Gly Leu Asp Leu Leu Ile Phe Leu Pro Leu Lys Lys
115 120 125

Tyr Val Arg Asp Phe Leu Ala Met Leu Asp Arg Lys Lys Thr Val Leu
130 135 140

Val Thr Ile Leu Ala Thr Leu Leu Phe Leu Arg Asn Pro Met Thr Ile
145 150 155 160

Val Ser Leu Leu Ile Tyr Ile Gly Leu Gly Leu Phe Phe Ala Ala Tyr
165 170 175

Leu Val Pro Asn Ser Val Lys Lys Glu Val Ser Phe Tyr Gly His Ile
180 185 190

Phe Arg Asp Leu Val Leu Val Ile Val Thr Leu Ile Phe Phe
195 200 205

<210> 384
<211> 702
<212> PRT
<213> Streptococcus pneumoniae

<400> 384

Met Lys Ile Pro Met Ile Tyr Gln Met Glu Asn Ser Glu Cys Gly Leu
1 5 10 15

Ala Cys Cys Ala Met Ile Leu Asn Tyr Phe Lys Tyr Glu Ile Ser Leu
20 25 30

Asn Glu Leu Arg Glu Ile Tyr Pro Ser Ser Arg Ser Gly Tyr Ser Leu
        35   40   45

Leu Ser Ile Ser Lys Val Leu Gly Asp Phe Asn Ile Ser Ser His Ala
    50   55   60

Phe Lys Ala Ser Val Arg Asp Leu Lys Pro Leu Ser Phe Pro Leu Ile
65   70   75   80

Cys Phe Trp Glu Ser Ser His Phe Ile Ile Leu Glu Lys Ile Ser Lys
                85   90   95

Asn Lys Phe Tyr Ile Leu Asp Pro Ala Lys Gly Arg Gln Arg Met Ser
            100   105   110

Ile Ser Glu Phe Glu Arg His Tyr Ser Asn Ile Ile Leu Thr Phe Lys
        115   120   125

Lys Leu Asp Ser Phe Met Ser Arg Lys Asp Asn Lys Lys Ser Pro Val
    130   135   140

Leu Lys Tyr Phe Phe Lys Tyr Arg Asn Lys Leu Gly Ile Leu Phe Phe
145   150   155   160

Val Thr Ala Leu Leu Tyr Val Ile Gln Ser Leu Val Pro Ile Ala Asn
                165   170   175

Arg Tyr Ile Ile Asp Thr Asn Phe Lys Asp Asp Ser Tyr Ser Ser Arg
            180   185   190

Met Leu Phe Thr Ile Leu Phe Ile Phe Thr Val Ser Phe Ser Leu Met
        195   200   205

Tyr Leu Leu Arg Gln Ile Tyr Val Ala Ser Leu Lys Tyr Ile Met Asp
    210   215   220

Lys Glu Ile Ser Tyr Asp Phe Met Lys His Leu Ile Tyr Leu Pro Tyr
225   230   235   240

Ser Phe Tyr Glu Lys Arg Thr Leu Gly Asp Ile Leu Phe Arg Ala Asn
                245   250   255

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Ser Ile Val Tyr Ile Arg Glu Ile Leu Ser Asn Asn Phe Ile Ala Ala
            260                 265                 270

Ile Leu Asp Leu Leu Met Ile Val Val Tyr Ala Val Val Leu Phe Ser
        275                 280                 285

Phe Ser Lys Tyr Met Val Ile Phe Leu Ile Ser Leu Ser Leu Ala Leu
    290                 295                 300

Ser Ile Val Met Tyr Pro Ile Ile Lys Ile Ser Lys Asn Leu Ile Asp
305                 310                 315                 320

Lys Asn Ile Lys Glu Lys Val Asn Val Gln Asn Ile Thr Ser Glu Val
                325                 330                 335

Ile Ser Lys Asn Ser Asp Ile Lys Leu Thr Gly Glu Glu Glu Phe Trp
            340                 345                 350

Ile Asn Lys Trp Asp Asn Phe Asn Thr Lys Gln Leu Ile Ile Gly Arg
        355                 360                 365

Lys Leu Asp Ile His Leu Ser Ile Val Ser Ser Ile Thr Asn Val Leu
    370                 375                 380

Gln Ile Ile Leu Pro Val Leu Thr Leu Ile Val Gly Val Asn Ile Lys
385                 390                 395                 400

Thr Phe Glu Gln Leu Thr Leu Gly Gln Ile Val Ala Ile Ser Thr Val
                405                 410                 415

Ser Pro Tyr Phe Ile Ser Pro Ile Ile Ser Leu Ser Asp Asn Tyr Ile
            420                 425                 430

Gln Leu Met Leu Leu Lys Gly Tyr Phe Leu Arg Ile Glu Asp Val Phe
        435                 440                 445

Asn Thr Lys Ser Glu Leu Ile Pro Glu Arg Val Ser Gln Asp Ile Lys
    450                 455                 460

Phe Asp Lys Lys Ile Glu Leu Lys Asp Ile Trp Tyr Lys Tyr Gly Leu
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465 470 475 480

Phe Asp Asp Tyr Val Leu Lys Gly Ile Asn Val Thr Ile Lys Lys Gly
485 490 495

Glu Thr Val Ala Ile Val Gly Glu Ser Gly Ser Gly Lys Ser Thr Leu
500 505 510

Ala Lys Ile Leu Leu Gly Leu Leu Glu Pro Asn Ile Gly Ser Ile Glu
515 520 525

Val Asp Gly Val Glu Lys Glu Glu Ile Gly Gln Thr Leu Tyr Arg Lys
530 535 540

Ile Phe Gly Ala Val Leu Gln Asn Ser Thr Leu Ser Tyr Gly Thr Leu
545 550 555 560

Arg Glu Asn Leu Thr Phe Gly His Phe Val Ser Asp Glu Glu Leu Met
565 570 575

Thr Asn Leu Asn Ser Ile Gly Leu Ser Asn Val Val Lys Ser Leu Pro
580 585 590

Leu Gly Leu Glu Thr Ile Ile Ala Glu Glu Gly Asn Asn Phe Ser Gly
595 600 605

Gly Gln Gln Gln Met Ile Leu Leu Ala Arg Cys Leu Leu Ser Lys Pro
610 615 620

Ser Val Val Val Leu Asp Glu Ala Thr Ser Ser Leu Asp Asn Leu Ser
625 630 635 640

Gln Gln Ile Thr Thr Ser Tyr Leu Ser Glu Ile Gly Thr Thr Lys Ile
645 650 655

Leu Ile Ala His Arg Leu Asp Thr Ile Lys Ser Ala Asp Lys Ile Leu
660 665 670

Val Met His Asn Gly Glu Ile Val Glu Ile Gly Thr His Arg Glu Leu
675 680 685

Leu Glu Leu Gly Gly Ile Tyr Lys Gln Leu Tyr Ser Asn Asn
690 695 700

<210> 385
<211> 103
<212> PRT
<213> Streptococcus pneumoniae

<400> 385

Met Leu Asn Ile Pro Asn Val Leu Arg Tyr Asp Leu Asn Met Leu Gln
1 5 10 15

Leu Glu Tyr Lys Asn Glu Gln Ser Trp Asp Ser Phe Ile Asp Asn Val
20 25 30

Asn Leu Ile Glu Leu Glu Glu Arg Ile Gln Thr Thr Ile Gly Ile Lys
35 40 45

Gln Ile Asn Thr His Asn Ile Ile Thr Ile Ala Arg Glu Gly Tyr Ser
50 55 60

Gln Asn Tyr Leu Pro Asn Thr Ser Glu Asn Thr Tyr Asn Ser Leu Gln
65 70 75 80

Val Ser Leu Val Gly Val Leu Leu Leu Phe Ile Ser Met Val Asn Ile
85 90 95

Leu Trp Ala Lys Lys Ser Lys
100

<210> 386
<211> 210
<212> PRT
<213> Streptococcus pneumoniae

<400> 386

Met Ile Glu Leu Lys Gln Val Ser Lys Ser Phe Gly Glu Arg Glu Leu
1 5 10 15

Phe Ser Asn Leu Ser Met Thr Phe Glu Ala Gly Lys Val Tyr Ala Leu
20 25 30

Ile Gly Ser Ser Gly Ser Gly Lys Thr Thr Leu Met Asn Met Ile Gly

35 40 45

Lys Leu Glu Pro Tyr Asp Gly Thr Ile Phe Tyr Arg Gly Lys Asp Leu
50 55 60

Ala Asn Tyr Lys Ser Ser Asp Phe Phe Arg His Glu Leu Gly Tyr Leu
65 70 75 80

Phe Gln Asn Phe Gly Leu Ile Glu Asn Gln Ser Ile Glu Glu Asn Leu
85 90 95

Lys Leu Gly Leu Ile Gly Gln Lys Leu Ser Arg Ser Glu Gln Arg Leu
100 105 110

Arg Gln Lys Gln Ala Leu Glu Gln Val Gly Leu Val Tyr Leu Asp Leu
115 120 125

Asp Lys Arg Ile Phe Glu Leu Ser Gly Gly Glu Ser Gln Arg Val Ala
130 135 140

Leu Ala Lys Ile Ile Leu Lys Asn Pro Pro Phe Ile Leu Ala Asp Glu
145 150 155 160

Pro Thr Ala Ser Ile Asp Pro Ala Thr Ser Gln Leu Ile Met Glu Ile
165 170 175

Leu Leu Ser Leu Arg Asp Asp Asn Arg Leu Ile Ile Ile Ala Thr His
180 185 190

Asn Pro Ala Ile Trp Glu Met Ala Asp Glu Val Phe Thr Met Asp His
195 200 205

Leu Lys
210

<210> 387
<211> 345
<212> PRT
<213> Streptococcus pneumoniae

<400> 387

Met Lys Lys Lys Ile Arg Trp Pro Leu Tyr Val Ile Ala Ala Leu Ile

1 5 10 15

Val Thr Phe Leu Ala Phe Val Val Pro Leu Pro Tyr Tyr Ile Glu Val
20 25 30

Pro Gly Gly Ser Glu Asp Ile Arg Gln Val Leu Lys Val Asn Asp Thr
35 40 45

Glu Asp Lys Glu Ala Gly Ala Tyr Gln Phe Val Thr Val Gly Val Gln
50 55 60

His Ala Thr Leu Ala His Met Ile Tyr Ala Trp Leu Thr Pro Phe Thr
65 70 75 80

Asp Ile Arg Ser Ala Gln Glu Thr Thr Gly Gly Ser Ser Asp Val Glu
85 90 95

Phe Met Arg Ile Asn Gln Phe Tyr Met Gln Thr Ser Gln Asn Met Ala
100 105 110

Lys Tyr Gln Gly Leu Lys Thr Ala Gly Lys Asp Ile Glu Leu Lys Tyr
115 120 125

Phe Gly Val Tyr Val Leu Asn Val Thr Asp Asn Ser Thr Phe Lys Gly
130 135 140

Ile Leu Asn Ile Ser Asp Thr Val Thr Ala Val Asn Asp Gln Thr Phe
145 150 155 160

Asp Ser Ser Lys Asp Leu Ile Asp Tyr Val Ser Ser Gln Lys Leu Gly
165 170 175

Asp Ser Val Lys Val Thr Tyr Glu Glu Asp Gly Gln Thr Lys Ser Ala
180 185 190

Glu Gly Lys Ile Ile Thr Leu Glu Asn Gly Lys Asn Gly Ile Gly Ile
195 200 205

Gly Leu Ile Asp Arg Thr Glu Val Ile Ser Asn Val Pro Ile Ser Phe
210 215 220

Ser Thr Ala Gly Ile Gly Gly Pro Ser Ala Gly Leu Met Phe Ser Leu
225 230 235 240

Ala Ile Tyr Thr Gln Ile Ala His Pro Asp Leu Arg Asn Gly Arg Ile
245 250 255

Val Ala Gly Thr Gly Thr Ile Asp Arg Asp Gly Asn Val Gly Asp Ile
260 265 270

Gly Gly Ile Asp Lys Lys Val Val Ala Ser Ala Arg Ala Gly Ala Ala
275 280 285

Ile Phe Phe Ala Pro Asp Asn Pro Val Ser Glu Glu Glu Gln Lys Ala
290 295 300

His Pro Asp Ala Lys Asn Asn Tyr Gln Thr Ala Leu Glu Ala Ala Lys
305 310 315 320

Thr Ile Lys Thr Asp Met Lys Ile Val Pro Val Lys Thr Leu Gln Asp
325 330 335

Ala Ile Asp Tyr Leu Lys Asn Asn Pro
340 345

<210> 388
<211> 308
<212> PRT
<213> Streptococcus pneumoniae

<400> 388

Met Lys Ser Ile Lys Arg Phe Ala Leu Ser Ala Met Gly Val Ala Met
1 5 10 15

Leu Leu Val Leu Thr Gly Cys Val Asn Val Asp Lys Thr Thr Gly Gln
20 25 30

Pro Thr Gly Phe Ile Trp Asn Thr Ile Gly Ala Pro Met Ala Glu Ala
35 40 45

Ile Lys Tyr Phe Ala Thr Asp Lys Gly Leu Gly Phe Gly Val Ala Ile
50 55 60

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Ile Ile Val Thr Ile Ile Val Arg Leu Ile Ile Leu Pro Leu Gly Ile
65                  70                  75                  80

Tyr Gln Ser Trp Lys Ala Thr Leu His Ser Glu Lys Met Asn Ala Leu
                85                  90                  95

Lys His Val Leu Glu Pro His Gln Thr Arg Leu Lys Glu Ala Thr Thr
            100                 105                 110

Gln Glu Glu Lys Leu Glu Ala Gln Gln Ala Leu Phe Ala Ala Gln Lys
        115                 120                 125

Glu His Gly Ile Ser Met Phe Gly Gly Val Gly Cys Phe Pro Ile Leu
    130                 135                 140

Leu Gln Met Pro Phe Phe Ser Ala Ile Tyr Phe Ala Ala Gln His Thr
145                 150                 155                 160

Glu Gly Val Ala Gln Ala Ser Tyr Leu Gly Ile Pro Leu Gly Ser Pro
                165                 170                 175

Ser Met Ile Leu Val Ala Cys Ala Gly Val Leu Tyr Tyr Leu Gln Ser
            180                 185                 190

Leu Leu Ser Leu His Gly Val Glu Asp Glu Met Gln Arg Glu Gln Ile
        195                 200                 205

Lys Lys Met Ile Tyr Met Ser Pro Leu Met Ile Val Val Phe Ser Leu
    210                 215                 220

Phe Ser Pro Ala Ser Val Thr Leu Tyr Trp Val Val Gly Gly Phe Met
225                 230                 235                 240

Met Ile Leu Gln Gln Phe Ile Val Asn Tyr Ile Val Arg Pro Lys Leu
                245                 250                 255

Arg Lys Lys Val Arg Glu Glu Leu Ala Lys Asn Pro Pro Lys Ala Ser
            260                 265                 270

Ala Phe Ser Lys Pro Ser Gly Arg Lys Asp Val Thr Pro Glu Gln Pro
        275                 280                 285
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Thr Ala Ile Thr Ser Lys Lys Lys His Lys Asn Arg Asn Ala Gly Lys
290 295 300

Gln Arg Ser Arg
305

<210> 389
<211> 213
<212> PRT
<213> Streptococcus pneumoniae

<400> 389

Met Ile Asp Ile Gln Gly Leu Glu Lys Lys Phe Asn Asp Arg Ala Ile
1 5 10 15

Phe Ser Gly Leu Asn Leu Lys Leu Glu Lys Gly Lys Val Tyr Ala Leu
20 25 30

Ile Gly Lys Ser Gly Ser Gly Lys Thr Thr Leu Leu Asn Ile Leu Gly
35 40 45

Lys Leu Glu Lys Ile Asp Gly Gly Arg Val Leu Tyr Gln Gly Lys Asp
50 55 60

Leu Lys Thr Ile Pro Thr Arg Glu Tyr Phe Arg Asp Gln Met Gly Tyr
65 70 75 80

Leu Phe Gln Asn Phe Gly Leu Leu Glu Asn Gln Ser Ile Lys Glu Asn
85 90 95

Leu Asp Leu Gly Phe Val Gly Gln Lys Ile Ser Lys Val Glu Arg Leu
100 105 110

Glu Arg Gln Val Gly Ala Leu Glu Lys Val Asn Leu Gly Tyr Leu Asp
115 120 125

Leu Glu Gln Lys Ile Tyr Thr Leu Ser Gly Gly Glu Ala Gln Arg Val
130 135 140

Ala Leu Ala Lys Thr Ile Leu Lys Asn Pro Pro Leu Ile Leu Ala Asp
145 150 155 160

Glu Pro Thr Ala Ala Leu Asp Pro Glu Asn Ser Glu Glu Val Met Asn
165 170 175

Leu Leu Val Asp Leu Lys Asp Glu Asn Arg Ile Ile Ile Ile Ala Thr
180 185 190

His Asn Pro Leu Val Trp Asn Lys Ala Asp Glu Ile Ile Asp Met Arg
195 200 205

Lys Leu Ala His Val
210

<210> 390
<211> 680
<212> PRT
<213> Streptococcus pneumoniae

<400> 390

Met Glu Glu Met Met Lys Arg Leu Phe Ile Leu Ile Ser Met Val Leu
1 5 10 15

Val Ser Leu Tyr Met Val Ile Thr Ser Val Asp His Arg Glu Glu Ile
20 25 30

Leu Phe Gly Asn Tyr Pro Ser Val Asp Val Thr Gly Met Met Ile Asn
35 40 45

Gln Pro Val Ala Ser Arg Glu Glu Val Thr Glu Ala Leu Ser His Leu
50 55 60

Ala Val Glu His Asn Ser Leu Ile Ala Arg Arg Ile Val Glu Pro Asn
65 70 75 80

Glu Ala Gly Glu Thr Arg Phe Thr Tyr Ala Thr Tyr Gly Glu Gly Lys
85 90 95

Leu Pro Glu Gly Leu Thr Ile Ser Ser Lys Glu Ser Ala Glu Thr Ser
100 105 110

Asp Leu Leu Gly Ser Tyr Leu Ile Val Ser Gly Ser Leu Asp Gly Val
115 120 125

Ser Leu Gln Thr Thr Leu Lys Glu Leu Gly Tyr Gln Gly Phe Val Ser
130 135 140

Asn Gly Glu Asp Pro Phe Ser Ile Val Leu Leu Leu Thr Ala Thr Pro
145 150 155 160

Met Val Leu Leu Ser Leu Ala Ile Phe Leu Leu Thr Phe Met Ser Leu
165 170 175

Thr Leu Ile Tyr Arg Ile Lys Ser Leu Arg Gln Ala Gly Ile Arg Leu
180 185 190

Ile Ala Gly Glu Ser Leu Phe Gly Val Ala Leu Arg Pro Val Leu Glu
195 200 205

Asp Val Arg Gln Leu Ile Cys Ser Val Leu Val Ser Ser Leu Leu Gly
210 215 220

Leu Gly Ile Leu Trp Tyr Gln Gly Ala Leu Phe Met Ala Thr Val Gln
225 230 235 240

Leu Val Ile Ile Ala Leu Leu Leu Tyr Gly Leu Thr Leu Ala Gly Ile
245 250 255

Ser Thr Leu Leu Ser Val Val Tyr Leu Leu Gly Leu Gln Glu Asn Ser
260 265 270

Leu Val Asp Leu Leu Lys Gly Lys Leu Pro Leu Lys Arg Met Met Thr
275 280 285

Leu Met Met Val Gly Gln Leu Leu Ala Val Leu Val Val Gly Ser Ser
290 295 300

Ala Thr Ala Leu Leu Pro His Tyr Arg Glu Met Gln Glu Met Glu Arg
305 310 315 320

Ala Ser Asn Lys Trp Ser Gln Ser Ser Asp Arg Tyr Arg Leu Ser Phe
325 330 335

Gly Trp Ser Ser Ala Phe Ala Asp Glu Glu Gly Thr Arg Lys Asp Asn
340 345 350

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Arg Glu Trp Gln Thr Phe Thr Glu Glu Arg Leu Ala Asn Thr Asp Ser
        355                 360                 365

Phe Tyr Ile Met Ser Asn Val Asp Asn Phe Ser Asp Gly Ala Glu Val
    370                 375                 380

Asp Leu Asp Gly Asn Arg Leu Ser Asp Tyr Thr Pro Ser Gly Asn Val
385                 390                 395                 400

Ile Tyr Val Ser Pro Arg Tyr Leu Ile Glu Glu Lys Ile Thr Val Ser
                405                 410                 415

Ser Glu Phe Met Asp Lys Met Gln Asn Leu Ser Glu Gly Glu Phe Gly
            420                 425                 430

Leu Ile Leu Pro Glu Ser Leu Arg Glu Gln Ser Val Tyr Tyr Gln Gly
        435                 440                 445

Leu Phe Thr Asp Tyr Leu Gln Asn Phe Ser Ser Glu Ser Val Glu Val
    450                 455                 460

Thr Ser Gln Lys His Tyr Leu Pro Gln Val Arg Leu Ala Phe Thr Glu
465                 470                 475                 480

Thr Gly Gln Glu Arg Phe Leu Tyr Asn Asp Gly Tyr Lys Thr Thr Arg
                485                 490                 495

Gln Tyr Leu Lys Asp Pro Ile Ile Val Val Leu Thr Pro Gln Ala Thr
            500                 505                 510

Gly Thr Arg Pro Val Ala Gly Met Leu Trp Gly Thr Thr Ala Asn Ser
        515                 520                 525

Ala Leu Lys Leu Asp Arg Tyr Gly Asp Ser Ile Thr Ala Leu Lys Glu
    530                 535                 540

Lys Gly Leu Tyr His Lys Val Ser Tyr Leu Val Lys Ser Gln Leu Phe
545                 550                 555                 560

Phe Ala Lys Val Leu Asn Asp Lys Arg Val Glu Phe Tyr Ser Leu Leu
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565 570 575

Ile Gly Thr Ile Leu Thr Leu Ser Thr Ala Ile Leu Leu Phe Asp Ser
580 585 590

Met Asn Leu Leu Tyr Phe Glu Gln Phe Arg Arg Glu Leu Met Ile Lys
595 600 605

Arg Leu Ala Gly Met Thr Ile Tyr Glu Leu His Gly Lys Tyr Leu Leu
610 615 620

Ala Gln Gly Gly Val Leu Leu Leu Gly Leu Val Leu Ser Ser Ile Leu
625 630 635 640

Thr Arg Asp Gly Leu Ile Ser Ala Leu Val Val Ala Leu Phe Thr Leu
645 650 655

Asn Ala Leu Leu Ile Leu Val Arg Gln Asp Lys Lys Glu Glu Ala Gly
660 665 670

Ser Met Ala Val Leu Lys Gly Lys
675 680

<210> 391
<211> 294
<212> PRT
<213> Streptococcus pneumoniae

<400> 391

Met Asn Met Ile Lys Val Glu Ser Leu Asn Lys Asn Ile Lys Gly Lys
1 5 10 15

Ala Ile Leu Lys Gly Ile Ser Phe Glu Val Ala Glu Gly Glu Cys Val
20 25 30

Ala Leu Ile Gly Pro Asn Gly Ala Gly Lys Thr Thr Leu Leu Asp Cys
35 40 45

Leu Leu Gly Asp Lys Leu Val Thr Ser Gly Gln Val Ser Ile Gln Gly
50 55 60

Leu Ser Val Thr Ser Ser Gln Leu Asp Tyr Ile Arg Gly Tyr Leu Pro

65 70 75 80

Gln Glu Asn Val Ile Val Gln Lys Leu Lys Val Lys Glu Leu Ile Ala
85 90 95

Phe Phe Gln Arg Ile Tyr Pro Asn Ser Leu Ser Asp Gln Glu Ile Asp
100 105 110

Gln Leu Leu Gln Phe Asp Gln Gln Gln Lys Glu Gln Phe Ala Glu Lys
115 120 125

Leu Ser Gly Gly Gln Lys Arg Leu Phe Ser Phe Val Leu Thr Leu Ile
130 135 140

Gly Arg Pro Lys Leu Val Phe Leu Asp Glu Pro Thr Ala Ala Met Asp
145 150 155 160

Thr Ser Thr Arg Gln Arg Phe Trp Glu Ile Val Arg Asp Leu Lys Ala
165 170 175

Gln Gly Val Thr Ile Leu Tyr Ser Ser His Tyr Ile Glu Glu Val Glu
180 185 190

His Thr Ala Asp Arg Ile Leu Val Leu Asn Lys Gly Glu Leu Ile Arg
195 200 205

Asp Thr Thr Pro Leu Ala Met Arg Ser Glu Gly Ile Glu Lys His Phe
210 215 220

Ile Leu Pro Leu Ala Tyr Lys Glu Val Ile Glu Gln Ser Asn Leu Val
225 230 235 240

Glu Asn Trp Ser Gln Lys Gln Asp Ala Leu Gln Val Val Thr Arg Glu
245 250 255

Ala Asp Ala Phe Trp Glu Leu Leu Val Gln Ala Gly Cys Gly Ile Gln
260 265 270

Glu Ile Glu Val Asn Asn Arg Ser Leu Leu Asp Thr Ile Phe Glu Glu
275 280 285

Thr Gln Lys Gly Asp Asn
    290

<210> 392
<211> 431
<212> PRT
<213> Streptococcus pneumoniae

<400> 392

Met Lys Asn Ser Lys Phe Ile Asp Gln Phe Ala Thr Phe Ala Gly Lys
1   5   10   15

Leu Gly Asn Gln Ile His Leu Lys Thr Leu Arg Asp Ala Phe Val Thr
            20   25   30

Val Met Pro Leu Tyr Ile Leu Ala Gly Leu Ile Val Leu Leu Asn Asn
        35   40   45

Thr Val Phe Lys Trp Ile Phe Gln Gly Asp Thr Leu Thr Arg Phe Gln
    50   55   60

Tyr Trp Gly Ile Thr Ile Ala Asn Gly Thr Leu Ser Ile Ser Gly Met
65   70   75   80

Ile Ile Ala Val Met Val Gly Tyr Phe Leu Ala Lys Asn Arg Asp Phe
                85   90   95

Glu Asn Pro Leu Ala Ala Ser Met Leu Ser Leu Val Ser Leu Ile Val
            100   105   110

Met Met Pro Asn Thr Val Ser Val Val Pro Asp Gly Ala Lys Asp Ala
        115   120   125

Val Asn Ile Ser Gly Val Leu Ser Phe Asn Asn Thr Gly Thr Gly Ala
    130   135   140

Met Phe Ala Gly Val Ile Val Ala Ile Ile Ala Thr Glu Leu Phe Ile
145   150   155   160

Glu Leu Ser Asn Val Lys Ala Leu Gln Met Asn Leu Gly Glu Asn Ile
                165   170   175

Pro Pro Ala Val Ser Arg Ser Phe Ser Val Leu Leu Pro Val Met Thr
180 185 190

Val Ile Ser Leu Phe Gly Val Val Ser Ala Leu Leu Phe Asn Ile Thr
195 200 205

Gly Met Asn Leu Ile Ser Ile Ile Thr Ile Phe Ile Gln Glu Pro Ile
210 215 220

Arg His Ile Gly Thr Ser Leu Ile Gly Val Ile Ile Ile Tyr Ser Leu
225 230 235 240

Gly Asn Met Leu Trp Leu Phe Gly Ile His Gln Ala Val Ile Tyr Ser
245 250 255

Ala Ile Leu Glu Pro Leu Leu Leu Ile Asn Ile Thr Glu Asn Ile Thr
260 265 270

Ala Ala Asn Asn Gly Gln Ala Ile Pro His Ile Ile Asn Leu Ser Gln
275 280 285

Ile Gln Thr Phe Ala Leu Met Gly Gly Ser Gly Ser Thr Leu Cys Leu
290 295 300

Leu Ile Ala Thr Phe Leu Val Ser Arg Asn Ala Val Ser Lys Asn Val
305 310 315 320

Ala Lys Leu Ser Phe Gly Pro Gly Ile Phe Asn Ile Asn Glu Pro Val
325 330 335

Leu Phe Gly Tyr Pro Ile Val Tyr Asn Ile Ser Leu Ala Ile Pro Phe
340 345 350

Ile Thr Val Pro Val Leu Gly Ile Leu Ile Ser Tyr Leu Ala Thr Val
355 360 365

Thr Glu Phe Met Ser Pro Ala Phe Ile Gln Val Pro Trp Thr Thr Pro
370 375 380

Val Phe Leu Asn Ala Trp Leu Ala Thr Ala Gly Asp Val Arg Ala Val
385 390 395 400

Leu Val Gln Phe Ile Ile Phe Ala Leu Gly Val Leu Leu Tyr Ile Pro
405 410 415

Phe Ile Lys Val Asn Asp Lys Val Val Glu Gln Glu Met Glu Gly
420 425 430

<210> 393
<211> 890
<212> PRT
<213> Streptococcus pneumoniae

<400> 393

Met Lys Ala Met Glu Glu Asn Met Ala Asp Lys Lys Thr Val Thr Pro
1 5 10 15

Glu Glu Lys Lys Leu Val Ala Glu Lys His Val Asp Glu Leu Val Gln
20 25 30

Lys Ala Leu Val Ala Leu Glu Glu Met Arg Lys Leu Asp Gln Glu Gln
35 40 45

Val Asp Tyr Ile Val Ala Lys Ala Ser Val Ala Ala Leu Asp Ala His
50 55 60

Gly Glu Leu Ala Leu His Ala Phe Glu Glu Thr Gly Arg Gly Val Phe
65 70 75 80

Glu Asp Lys Ala Thr Lys Asn Leu Phe Ala Cys Glu His Val Val Asn
85 90 95

Asn Met Arg His Thr Lys Thr Val Gly Val Ile Glu Glu Asp Asp Val
100 105 110

Thr Gly Leu Thr Leu Ile Ala Glu Pro Val Gly Val Val Cys Gly Ile
115 120 125

Thr Pro Thr Thr Asn Pro Thr Ser Thr Ala Ile Phe Lys Ser Leu Ile
130 135 140

Ser Leu Lys Thr Arg Asn Pro Ile Val Phe Ala Phe His Pro Ser Ala
145 150 155 160

Gln Glu Ser Ser Ala His Ala Ala Arg Ile Val Arg Asp Ala Ala Ile
165 170 175

Ala Ala Gly Ala Pro Glu Asn Cys Val Gln Trp Ile Thr Gln Pro Ser
180 185 190

Met Glu Ala Thr Ser Ala Leu Met Asn His Glu Gly Val Ala Thr Ile
195 200 205

Leu Ala Thr Gly Gly Asn Ala Met Val Lys Ala Ala Tyr Ser Cys Gly
210 215 220

Lys Pro Ala Leu Gly Val Gly Ala Gly Asn Val Pro Ala Tyr Val Glu
225 230 235 240

Lys Ser Ala Asn Ile Arg Gln Ala Ala His Asp Ile Val Met Ser Lys
245 250 255

Ser Phe Asp Asn Gly Met Val Cys Ala Ser Glu Gln Ala Val Ile Ile
260 265 270

Asp Lys Glu Ile Tyr Asp Glu Phe Val Ala Glu Phe Lys Ser Tyr His
275 280 285

Thr Tyr Phe Val Asn Lys Lys Glu Lys Ala Leu Leu Glu Glu Phe Cys
290 295 300

Phe Gly Val Lys Ala Asn Ser Lys Asn Cys Ala Gly Ala Lys Leu Asn
305 310 315 320

Ala Asp Ile Val Gly Lys Pro Ala Thr Trp Ile Ala Glu Gln Ala Gly
325 330 335

Phe Thr Val Pro Glu Gly Thr Asn Ile Leu Ala Ala Glu Cys Lys Glu
340 345 350

Val Gly Glu Asn Glu Pro Leu Thr Arg Glu Lys Leu Ser Pro Val Ile
355 360 365

Ala Val Leu Lys Ser Glu Ser Arg Glu Asp Gly Ile Thr Lys Ala Arg
370 375 380

Gln Met Val Glu Phe Asn Gly Leu Gly His Ser Ala Ala Ile His Thr
385 390 395 400

Ala Asp Glu Glu Leu Thr Lys Glu Phe Gly Lys Ala Val Lys Ala Ile
405 410 415

Arg Val Ile Cys Asn Ser Pro Ser Thr Phe Gly Gly Ile Gly Asp Val
420 425 430

Tyr Asn Ala Phe Leu Pro Ser Leu Thr Leu Gly Cys Gly Ser Tyr Gly
435 440 445

Arg Asn Ser Val Gly Asp Asn Val Ser Ala Ile Asn Leu Leu Asn Ile
450 455 460

Lys Lys Val Gly Arg Arg Arg Asn Asn Met Gln Trp Met Lys Leu Pro
465 470 475 480

Ser Lys Thr Tyr Phe Glu Arg Asp Ser Ile Gln Tyr Leu Gln Lys Cys
485 490 495

Arg Asp Val Glu Arg Val Met Ile Val Thr Asp His Ala Met Val Glu
500 505 510

Leu Gly Phe Leu Asp Arg Ile Ile Glu Gln Leu Asp Leu Arg Arg Asn
515 520 525

Lys Val Val Tyr Gln Ile Phe Ala Asp Val Glu Pro Asp Pro Asp Ile
530 535 540

Thr Thr Val Asn Arg Gly Thr Glu Ile Met Arg Ala Phe Lys Pro Asp
545 550 555 560

Thr Ile Ile Ala Leu Gly Gly Gly Ser Pro Met Asp Ala Ala Lys Val
565 570 575

Met Trp Leu Phe Tyr Glu Gln Pro Glu Val Asp Phe Arg Asp Leu Val
580 585 590

Gln Lys Phe Met Asp Ile Arg Lys Arg Ala Phe Lys Phe Pro Leu Leu

595 600 605

Gly Lys Lys Thr Lys Phe Ile Ala Ile Pro Thr Thr Ser Gly Thr Gly
610 615 620

Ser Glu Val Thr Pro Phe Ala Val Ile Ser Asp Lys Ala Asn Asn Arg
625 630 635 640

Lys Tyr Pro Ile Ala Asp Tyr Ser Leu Thr Pro Thr Val Ala Ile Val
645 650 655

Asp Pro Ala Leu Val Leu Thr Val Pro Gly Phe Val Ala Ala Asp Thr
660 665 670

Gly Met Asp Val Leu Thr His Ala Thr Glu Ala Tyr Val Ser Gln Met
675 680 685

Ala Ser Asp Tyr Thr Asp Gly Leu Ala Leu Gln Ala Ile Lys Leu Val
690 695 700

Phe Glu Asn Leu Glu Ser Ser Val Lys Asn Ala Asp Phe His Ser Arg
705 710 715 720

Glu Lys Met His Asn Ala Ser Thr Ile Ala Gly Met Ala Phe Ala Asn
725 730 735

Ala Phe Leu Gly Ile Ser His Ser Met Ala His Lys Ile Gly Ala Gln
740 745 750

Phe His Thr Ile His Gly Arg Thr Asn Ala Ile Leu Leu Pro Tyr Val
755 760 765

Ile Arg Tyr Asn Gly Thr Arg Pro Ala Lys Thr Ala Thr Trp Pro Lys
770 775 780

Tyr Asn Tyr Tyr Arg Ala Asp Glu Lys Tyr Gln Asp Ile Ala Arg Met
785 790 795 800

Leu Gly Leu Pro Ala Ser Thr Pro Glu Glu Gly Val Glu Ser Tyr Ala
805 810 815

Lys Ala Val Tyr Glu Leu Gly Glu Arg Ile Gly Ile Gln Met Asn Phe
820 825 830

Arg Asp Gln Gly Ile Asp Glu Lys Glu Trp Lys Glu His Ser Arg Lys
835 840 845

Leu Ala Phe Leu Ala Tyr Glu Asp Gln Cys Ser Pro Ala Asn Pro Arg
850 855 860

Leu Pro Met Val Asp His Met Gln Glu Ile Ile Glu Asp Ala Tyr Tyr
865 870 875 880

Gly Tyr Lys Glu Arg Pro Gly Arg Arg Lys
885 890

<210> 394
<211> 99
<212> PRT
<213> Streptococcus pneumoniae

<400> 394

Met Asn Pro Asn Ile Thr Phe Leu Ile Met Leu Val Gly Met Met Ala
1 5 10 15

Leu Met Phe Phe Met Gln Arg Ser Gln Lys Lys Gln Ala Gln Lys Arg
20 25 30

Met Glu Ser Leu Asn Lys Leu Gln Lys Gly Tyr Glu Val Ile Thr Ile
35 40 45

Gly Gly Leu Tyr Gly Thr Val Asp Glu Val Asp Thr Glu Lys Gly Thr
50 55 60

Ile Val Leu Asp Val Asp Gly Val Tyr Leu Thr Phe Glu Leu Ala Ala
65 70 75 80

Ile Lys Thr Val Leu Pro Leu Lys Glu Thr Ala Ser Leu Glu Gly Ala
85 90 95

Ile Glu Lys

<210> 395
<211> 605
<212> PRT
<213> Streptococcus pneumoniae

<400> 395

Met Arg Ile Lys Trp Phe Ser Leu Ile Arg Ile Ile Gly Leu Leu Leu
1 5 10 15

Val Leu Leu Tyr His Phe Phe Gln Thr Ile Phe Pro Gly Gly Phe Phe
20 25 30

Gly Val Asp Val Phe Phe Thr Phe Ser Gly Phe Leu Ile Thr Ala Leu
35 40 45

Leu Ile Glu Glu Phe Ser Lys Asn Asn Glu Ile Asp Leu Ile Gly Phe
50 55 60

Phe Arg Arg Arg Phe Tyr Arg Ile Val Pro Pro Val Val Leu Met Val
65 70 75 80

Leu Val Thr Met Pro Phe Thr Phe Leu Val Arg Gln Asp Tyr Val Ala
85 90 95

Gly Ile Gly Gly Gln Ile Ala Gly Val Leu Gly Phe Met Thr Asn Phe
100 105 110

Tyr Glu Leu Leu Thr Gly Gly Ser Tyr Glu Ser Gln Phe Ile Pro His
115 120 125

Leu Phe Val His Asn Trp Ser Leu Ala Val Glu Val His Tyr Tyr Ile
130 135 140

Leu Trp Gly Leu Ala Val Trp Phe Leu Ser Lys Gln Ala Lys Ser Asn
145 150 155 160

Gly Gln Leu Lys Gly Met Val Phe Leu Leu Ser Ala Val Ala Phe Leu
165 170 175

Ile Ser Phe Phe Ser Met Phe Ile Gly Ser Phe Leu Val Thr Ser Tyr
180 185 190

Ser Ser Val Tyr Phe Ser Ser Leu Thr His Val Tyr Pro Phe Phe Leu
195 200 205

Gly Ser Met Leu Ala Thr Ile Val Gly Val Arg Gln Thr Thr Ser Leu
210 215 220

Val Lys Gln Leu Asp Lys Ile Trp Asp Leu Arg Lys Thr Leu Val Val
225 230 235 240

Phe Gly Gly Gly Phe Gly Phe Leu Val Leu Leu Thr Phe Phe Val Lys
245 250 255

Phe Thr Tyr Leu Phe Ala Tyr Leu Ile Gly Phe Leu Leu Ala Ser Leu
260 265 270

Ala Ala Leu Ala Met Ile Leu Ala Ala Arg Val Leu His Glu Lys Thr
275 280 285

His His Ile Gln Glu Ser Lys Ile Ile Ser Phe Leu Ala Asp Thr Ser
290 295 300

Tyr Ala Val Tyr Leu Phe His Trp Pro Phe Tyr Ile Ile Phe Ser Gln
305 310 315 320

Leu Thr Ser Asn Leu Leu Ala Val Leu Leu Thr Leu Ile Cys Ser Tyr
325 330 335

Gly Phe Ala Ser Leu Ser Phe Tyr Val Leu Glu Pro Trp Ile Ala Gly
340 345 350

Lys Asn Thr Pro Ile Val Gln Thr Leu Arg Pro Leu Pro Tyr Ile His
355 360 365

Ala Ile Leu Ala Ala Gly Thr Gly Ile Leu Thr Ile Ile Val Cys Thr
370 375 380

Val Thr Leu Leu Ala Pro Gln Val Gly Ala Phe Glu Thr Asp Leu Thr
385 390 395 400

Val Asn Gly Leu Lys Gln Ala Ala Thr Asn Ile Gly Gln Thr Lys Val
405 410 415

Met Ala Glu Arg Ala Asp Ala Asn Ser Leu Gly Ile Ala Asp Gly Thr
420 425 430

Met Leu Ile Gly Asp Ser Val Ala Leu Arg Ala Asn Thr Ala Leu Gln
435 440 445

Thr Ala Leu Pro Gly Ala Gln Ile Asn Ala Gln Val Ser Val Thr Thr
450 455 460

Lys Thr Ala Asn Glu Ile Met Leu Asn Asn Ser Gln Asn Lys Phe Leu
465 470 475 480

Pro Lys Thr Val Val Ile Ala Thr Gly Val Asn Asn Pro Glu Asn Tyr
485 490 495

Lys Asp Asp Trp Asp Ser Ile Val Lys Asn Leu Pro Lys Gly His His
500 505 510

Met Ile Leu Val Thr Pro Tyr Glu Gly Asp Lys Thr Lys Glu Thr Tyr
515 520 525

Ala Ile Val Glu Lys Ala Ala Ala Tyr Met Arg Glu Leu Ala Glu Lys
530 535 540

Thr Pro Tyr Ile Thr Ile Ala Asp Trp Asn Gln Val Ala Lys Glu His
545 550 555 560

Pro Glu Ile Trp Ala Gly Thr Asp Gln Val His Phe Gly Ser Glu Ser
565 570 575

Ser Thr Ile Glu Ala Gly Ala Lys Leu Tyr Ala Asp Thr Ile Ala Thr
580 585 590

Ala Leu Gln Thr Ala Gln Asp Lys Pro Val Lys Ser Lys
595 600 605

<210> 396
<211> 119
<212> PRT
<213> Streptococcus pneumoniae

<400> 396

Met Ser Ile Ile Leu Thr Thr Ile Val Ala Leu Glu His Phe Tyr Ile
1 5 10 15

Phe Tyr Leu Glu Ser Ile Ala Thr Gln Ser Asp Ala Thr Ser Arg Val
20 25 30

Phe Asn Met Glu Lys Glu Glu Leu Ala His Pro Ser Val Ser Ser Leu
35 40 45

Phe Lys Asn Gln Gly Ile Tyr Lys Ala Leu Leu Gly Val Phe Leu Leu
50 55 60

Tyr Val Ile Tyr Phe Ser Gln Asn Leu Glu Ile Val Thr Ile Phe Val
65 70 75 80

Leu Phe Val Ile Gly Ala Ala Thr Tyr Gly Ser Leu Thr Ala Asp Lys
85 90 95

Lys Ile Ile Leu Lys Gln Gly Gly Ser Ala Ile Leu Ala Leu Ile Ser
100 105 110

Ile Leu Leu Phe Lys Tyr Thr
115

<210> 397
<211> 603
<212> PRT
<213> Streptococcus pneumoniae

<400> 397

Met Ala Val Ala Asn Cys Ala Lys Tyr Asn Ile Arg Arg Ser Lys Met
1 5 10 15

Lys Thr Val Gln Phe Phe Trp His Tyr Phe Lys Val Tyr Lys Phe Ser
20 25 30

Phe Val Val Val Ile Leu Met Ile Val Leu Ala Thr Phe Ala Gln Ala
35 40 45

Leu Phe Pro Val Phe Ser Gly Gln Ala Val Thr Gln Leu Ala Asn Leu
50 55 60

Val Gln Ala Tyr Gln Asn Gly Asn Pro Glu Leu Val Trp Gln Ser Leu
65 70 75 80

Ser Gly Ile Met Val Asn Leu Gly Leu Leu Val Leu Val Leu Phe Ile
85 90 95

Ser Ser Val Ile Tyr Met Cys Leu Met Thr Arg Val Ile Ala Glu Ser
100 105 110

Thr Asn Glu Met Arg Lys Gly Leu Phe Gly Lys Leu Ala Gln Leu Thr
115 120 125

Val Ser Phe Phe Asp Arg Arg Gln Asp Gly Asp Ile Leu Ser His Phe
130 135 140

Thr Ser Asp Leu Asp Asn Ile Leu Gln Ala Phe Asn Glu Ser Leu Ile
145 150 155 160

Gln Val Met Ser Asn Ile Val Leu Tyr Ile Gly Leu Ile Leu Val Met
165 170 175

Phe Ser Arg Asn Val Thr Leu Ala Leu Ile Thr Ile Ala Ser Thr Pro
180 185 190

Leu Ala Phe Leu Met Leu Ile Phe Ile Val Lys Met Ala Arg Lys Tyr
195 200 205

Thr Asn Leu Gln Gln Lys Glu Val Gly Lys Leu Asn Ala Tyr Met Asp
210 215 220

Glu Ser Ile Ser Gly Gln Lys Ala Val Ile Val Gln Gly Ile Gln Glu
225 230 235 240

Asp Met Met Ala Gly Phe Leu Glu Gln Asn Glu Arg Val Arg Lys Ala
245 250 255

Thr Phe Lys Gly Arg Met Phe Ser Gly Ile Leu Phe Pro Val Met Asn
260 265 270

Gly Met Ser Leu Ile Asn Thr Ala Ile Val Ile Phe Ala Gly Ser Ala
275 280 285

Val Leu Leu Asn Asp Lys Ser Ile Glu Thr Ser Thr Ala Leu Gly Leu
290 295 300

Ile Val Met Phe Ala Gln Phe Ser Gln Gln Tyr Tyr Gln Pro Ile Ile
305 310 315 320

Gln Val Ala Ala Ser Trp Gly Ser Leu Gln Leu Ala Phe Thr Gly Ala
325 330 335

Glu Arg Ile Gln Glu Met Phe Asp Ala Glu Glu Glu Ile Arg Pro Glu
340 345 350

Lys Ala Pro Thr Phe Thr Lys Leu Gln Glu Ser Val Glu Ile Ser His
355 360 365

Ile Val Phe Ser Tyr Leu Pro Asp Lys Pro Ile Leu Lys Asp Val Ser
370 375 380

Ile Ser Ala Pro Lys Gly Gln Met Thr Ala Val Val Gly Pro Thr Gly
385 390 395 400

Ser Gly Lys Thr Thr Ile Met Asn Leu Ile Asn Arg Phe Tyr Asp Val
405 410 415

Asp Ala Gly Gly Ile Tyr Phe Asp Gly Lys Asp Ile Arg Gly Tyr Asp
420 425 430

Leu Asp Ser Leu Arg Ser Lys Val Gly Ile Val Leu Gln Asp Ser Val
435 440 445

Leu Phe Ser Gly Thr Ile Arg Asp Asn Ile Arg Phe Gly Val Pro Asp
450 455 460

Ala Ser Gln Glu Met Val Glu Val Ala Ala Lys Ala Thr His Ile His
465 470 475 480

Asp Tyr Ile Glu Ser Leu Pro Asp Lys Tyr Asp Thr Leu Ile Asp Asp
485 490 495

Asp Gln Ser Ile Phe Ser Thr Gly Gln Lys Gln Leu Ile Ser Ile Ala

500 505 510

Arg Thr Leu Met Thr Asp Pro Glu Val Leu Ile Leu Asp Glu Ala Thr
515 520 525

Ser Asn Val Asp Thr Val Thr Glu Ser Lys Ile Gln His Ala Met Glu
530 535 540

Val Val Val Ala Gly Arg Thr Ser Phe Val Ile Ala His Arg Leu Lys
545 550 555 560

Thr Ile Leu Asn Ala Asp Gln Ile Ile Val Leu Lys Asp Gly Glu Val
565 570 575

Ile Glu Arg Gly Asn His His Glu Leu Leu Lys Leu Gly Gly Phe Tyr
580 585 590

Ser Glu Leu Tyr His Asn Gln Phe Val Phe Glu
595 600

<210> 398
<211> 250
<212> PRT
<213> Streptococcus pneumoniae

<400> 398

Met Gly Thr Phe Ser Val Arg His Leu Asp Leu Phe Tyr Gly Asp Phe
1 5 10 15

Gln Ala Leu Lys Asn Ile Ser Ile Gln Leu Pro Glu Arg Gln Ile Thr
20 25 30

Ala Leu Ile Gly Pro Ser Gly Cys Gly Lys Ser Thr Phe Leu Lys Thr
35 40 45

Leu Asn Arg Met Asn Asp Leu Val Pro Ser Cys His Ile Glu Gly Gln
50 55 60

Val Leu Leu Asp Glu Gln Asp Ile Tyr Ser Ser Lys Phe Asn Leu Asn
65 70 75 80

Gln Leu Arg Lys Arg Val Gly Met Val Phe Gln Gln Pro Asn Pro Phe

85 90 95

Ala Met Ser Ile Tyr Asp Asn Val Ala Tyr Gly Pro Arg Thr His Gly
100 105 110

Ile Arg Asp Lys Lys Gln Leu Asp Ala Leu Val Glu Lys Ser Leu Lys
115 120 125

Gly Ala Ala Ile Trp Glu Glu Val Lys Asp Asp Leu Lys Lys Ser Ala
130 135 140

Met Ser Leu Ser Gly Gly Gln Gln Gln Arg Leu Cys Ile Ala Arg Ala
145 150 155 160

Leu Ala Val Glu Pro Asp Ile Leu Leu Met Asp Glu Pro Thr Ser Ala
165 170 175

Leu Asp Pro Ile Ser Thr Leu Lys Ile Glu Asp Leu Ile Gln Gln Leu
180 185 190

Lys Lys Asp Tyr Thr Ile Ile Ile Val Thr His Asn Met Gln Gln Ala
195 200 205

Ser Arg Ile Ser Asp Lys Thr Ala Phe Phe Leu Thr Gly Glu Ile Cys
210 215 220

Glu Phe Gly Asp Thr Val Asp Val Phe Thr Asn Pro Lys Asp Gln Arg
225 230 235 240

Thr Glu Asp Tyr Ile Ser Gly Arg Phe Gly
245 250

<210> 399
<211> 226
<212> PRT
<213> Streptococcus pneumoniae

<400> 399

Met Met Lys Glu Ile Phe Asp Arg Arg Tyr Pro Val Thr Ser Phe Phe
1 5 10 15

Leu Leu Val Thr Ala Leu Val Phe Leu Leu Met Leu Val Thr Ala Gly

20 25 30

Gly Asn Phe Asp Arg Ala Asp Thr Leu Phe Arg Phe Gly Ala Met Tyr
35 40 45

Gly Pro Ala Ile Arg Leu Phe Pro Glu Gln Val Trp Arg Leu Leu Ser
50 55 60

Ala Ile Phe Val His Ile Gly Trp Glu His Phe Ile Val Asn Met Leu
65 70 75 80

Ser Leu Tyr Tyr Leu Gly Arg Gln Val Glu Glu Ile Phe Gly Ser Lys
85 90 95

Gln Phe Phe Phe Leu Tyr Leu Leu Ser Gly Met Met Gly Asn Leu Phe
100 105 110

Val Phe Val Phe Ser Pro Lys Ser Leu Ala Ala Gly Ala Ser Thr Ser
115 120 125

Leu Tyr Gly Leu Phe Ala Ala Ile Ile Val Leu Arg Tyr Ala Thr Arg
130 135 140

Asn Pro Tyr Ile Gln Gln Leu Gly Gln Ser Tyr Leu Thr Leu Phe Val
145 150 155 160

Val Asn Ile Ile Gly Ser Val Leu Ile Pro Gly Ile Ser Leu Ala Gly
165 170 175

His Ile Gly Gly Ala Val Gly Gly Ala Phe Leu Ala Val Ile Phe Pro
180 185 190

Val Arg Gly Glu Lys Arg Met Tyr Asn Thr Ser Gln Arg Leu Gly Ala
195 200 205

Val Val Leu Phe Val Gly Leu Ala Ile Leu Leu Phe Tyr Lys Gly Met
210 215 220

Gly Leu
225

<210> 400
<211> 232
<212> PRT
<213> Streptococcus pneumoniae

<400> 400

Met Thr Ala Thr Lys Met Asn Ala Gln Glu Ile Ile Gln Phe Ile Ala
1 5 10 15

Asn Ala Glu Lys Lys Thr Ser Val Lys Val Thr Phe Glu Gly Gln Leu
20 25 30

Ala Thr Ala Val Pro Ser Ser Val Val Lys Leu Gly Asn Val Leu Phe
35 40 45

Gly Asp Trp Lys Asp Val Ala Pro Leu Leu Glu Gly Leu Val Glu Asn
50 55 60

Gln Asp Tyr Val Val Glu Gln Asp Ala Arg Asn Ser Ala Val Pro Leu
65 70 75 80

Leu Asp Lys Arg Ala Ile Asn Ala Arg Ile Glu Pro Gly Ala Ile Ile
85 90 95

Arg Asp Gln Val Glu Ile Gly Asp Asn Ala Val Ile Met Met Gly Ser
100 105 110

Val Ile Asn Ile Gly Ala Glu Ile Gly Ala Gly Thr Met Ile Asp Met
115 120 125

Gly Ala Ile Leu Gly Gly Arg Ala Ile Val Gly Lys Asn Ser His Val
130 135 140

Gly Ala Gly Ala Val Leu Ala Gly Val Ile Glu Pro Ala Ser Ala Glu
145 150 155 160

Pro Val Arg Val Gly Asp Asn Val Leu Ile Gly Ala Asn Ala Val Val
165 170 175

Ile Glu Gly Val Gln Ile Gly Ser Gly Ser Val Val Ala Ala Gly Ala
180 185 190

Ile Val Thr Gln Asp Val Pro Glu Asn Val Val Val Ala Gly Val Pro
195 200 205

Ala Arg Ile Ile Lys Glu Ile Asp Ala Gln Thr Gln Gln Lys Thr Ala
210 215 220

Leu Glu Asp Ala Leu Arg Thr Leu
225 230

<210> 401
<211> 361
<212> PRT
<213> Streptococcus pneumoniae

<400> 401

Met Trp Gly Val Tyr Gln Leu His Pro Ala Pro Ala Val Gln Val Val
1 5 10 15

Val Leu Ala Ile Ala Val Thr Gln Val Leu His Asp Leu Leu Leu Gln
20 25 30

Gly Arg Asp Asp Asn Ser Leu Asn Glu Val Ala Asn Gln Trp Ile Ala
35 40 45

Thr Phe Phe Leu Ser Cys Tyr Asn Lys Gly Met Asn Gln Tyr Gln Lys
50 55 60

Lys Ile Val Asn Gly Lys Ile Tyr Ser Leu Leu Ser Gly Leu Ile Trp
65 70 75 80

Gly Ile Cys Gly Ile Leu Gly Glu Tyr Phe Phe Thr His Tyr Gln Val
85 90 95

Ser Ser Gly Trp Ile Thr Ser Met Arg Leu Thr Leu Ala Gly Ser Leu
100 105 110

Val Leu Ile Trp Ser Ala Ile Gln Leu Lys Ser Gln Val Leu Asp Ile
115 120 125

Trp Arg Asp Lys Lys Asn Tyr Leu Pro Phe Leu Ala Tyr Ala Ile Leu
130 135 140

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Gly Ile Phe Ser Val Gln Tyr Phe Phe Tyr Leu Cys Val Glu Tyr Ser
145                 150                 155                 160

Asn Ala Thr Thr Ala Thr Ile Leu Gln Phe Ile Ser Pro Val Phe Ile
                165                 170                 175

Leu Phe Tyr Asn Arg Leu Val Tyr Gln Lys Arg Ala Ser Lys Ser Ala
            180                 185                 190

Val Phe Tyr Val Leu Val Ala Met Leu Gly Val Cys Leu Met Ala Thr
        195                 200                 205

Lys Gly Asp Leu Ser Gln Leu Ser Met Thr Pro Leu Ala Leu Ile Thr
    210                 215                 220

Gly Leu Leu Ser Ala Met Gly Val Met Phe Asn Val Ile Leu Pro Gln
225                 230                 235                 240

Pro Phe Ala Lys Arg Tyr Gly Phe Val Pro Thr Val Gly Trp Gly Met
                245                 250                 255

Ile Leu Ala Gly Leu Phe Ser Asn Val Leu Ser Pro Val Tyr Gln Leu
            260                 265                 270

Ser Phe Thr Leu Asp Ile Trp Ser Ile Leu Ile Cys Leu Ile Ile Ala
        275                 280                 285

Phe Phe Gly Thr Ala Phe Ala Phe Phe Ile Ser Met Lys Ala Val Ser
    290                 295                 300

Leu Val Ser Pro Leu Val Val Ala Val Ile Ser Ala Ser Glu Pro Leu
305                 310                 315                 320

Ser Ser Ala Leu Leu Ser Val Leu Phe Leu Gly Leu Val Val Asp Trp
                325                 330                 335

Ser Leu Leu Leu Ala Ile Ala Leu Ile Ile Leu Pro Met Ile Phe Leu
            340                 345                 350

Ser Ile Glu Glu Ala Lys Glu Ser Arg
        355                 360
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<210> 402
<211> 190
<212> PRT
<213> Streptococcus pneumoniae

<400> 402

Met Asn Lys Leu Met Lys Phe Ile Ser Val Phe Leu Thr Ser Ile Val
1 5 10 15

Leu Ile Val Ser Ala Ile Pro Ser Val Ser Ala Val Tyr Ala Ser Glu
20 25 30

Gln Val Ser Gln Ile Glu Thr Asn Met Glu Leu Gln Pro Val Thr Ser
35 40 45

Leu Thr Glu Glu Gln Ile Asn Thr Leu Ala Asn Glu Ile Gln Ser Phe
50 55 60

His Pro Asp Val Ser Gln Gln Trp Ile Lys Glu Val Ile Asn Arg Gln
65 70 75 80

Leu Gln Gly Asp Tyr Thr Ile Pro Pro Thr Tyr Ser Pro Phe Arg Ala
85 90 95

Val Trp Gln Gly Ile Thr Val Asn Gln Met Gly Ala Leu Leu Asp Thr
100 105 110

Ala Ile Ala Leu Ala Leu Gly Gly Thr Thr Ala Gly Leu Ala Asn Leu
115 120 125

Ile Lys Val Lys Gly Lys His Ala Ala Lys Ser Ala Ile Arg Ser Ala
130 135 140

Ile Ser Arg Tyr Leu Gly Ser Trp Phe Val Asn Asp Val Ala Leu Glu
145 150 155 160

Phe Ala Met Asn Leu Leu Ser Pro Gly Thr Tyr Leu Ala Gln Leu Trp
165 170 175

Asp Lys Asn Asp Ala Ile Pro Asn Asn Gly Arg Ile Asn Phe
180 185 190

<210> 403
<211> 435
<212> PRT
<213> Streptococcus pneumoniae

<400> 403

Met Lys Gly Val Asn Met Glu Lys Gln Gln Pro Ser Lys Ala Ala Leu
1 5 10 15

Leu Ser Ile Ile Pro Gly Leu Gly Gln Ile Tyr Asn Lys Gln Lys Ala
20 25 30

Lys Gly Phe Ile Phe Leu Gly Val Thr Ile Val Phe Val Leu Tyr Phe
35 40 45

Leu Ala Leu Ala Thr Pro Glu Leu Ser Asn Leu Ile Thr Leu Gly Asp
50 55 60

Lys Pro Gly Arg Asp Asn Ser Leu Phe Met Leu Ile Arg Gly Ala Phe
65 70 75 80

His Leu Ile Phe Val Ile Val Tyr Val Leu Phe Tyr Phe Ser Asn Ile
85 90 95

Lys Asp Ala His Thr Ile Ala Lys Arg Ile Asn Asn Gly Ile Pro Val
100 105 110

Pro Arg Thr Leu Lys Asp Met Ile Lys Gly Ile Tyr Glu Asn Gly Phe
115 120 125

Pro Tyr Leu Leu Ile Ile Pro Ser Tyr Val Ala Met Thr Phe Ala Ile
130 135 140

Ile Phe Pro Val Ile Val Thr Leu Met Ile Ala Phe Thr Asn Tyr Asp
145 150 155 160

Phe Gln His Leu Pro Pro Asn Lys Leu Leu Asp Trp Val Gly Leu Thr
165 170 175

Asn Phe Thr Asn Ile Trp Ser Leu Ser Thr Phe Arg Ser Ala Phe Gly
180 185 190

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Ser Val Leu Ser Trp Thr Ile Ile Trp Ala Leu Ala Ala Ser Thr Leu
        195                 200                 205

Gln Ile Val Ile Gly Ile Phe Thr Ala Ile Ile Ala Asn Gln Pro Phe
    210                 215                 220

Ile Lys Gly Lys Arg Ile Phe Gly Val Ile Phe Leu Leu Pro Trp Ala
225                 230                 235                     240

Val Pro Ala Phe Ile Thr Ile Leu Thr Phe Ser Asn Met Phe Asn Asp
                245                 250                 255

Ser Val Gly Ala Ile Asn Thr Gln Val Leu Pro Ile Leu Ala Lys Phe
            260                 265                 270

Leu Pro Phe Leu Asp Gly Ala Leu Ile Pro Trp Lys Thr Asp Pro Thr
        275                 280                 285

Trp Thr Lys Ile Ala Leu Ile Met Met Gln Gly Trp Leu Gly Phe Pro
    290                 295                 300

Tyr Ile Tyr Val Leu Thr Leu Gly Ile Leu Gln Ser Ile Pro Asn Asp
305                 310                 315                     320

Leu Tyr Glu Ala Ala Tyr Ile Asp Gly Ala Asn Ala Trp Gln Lys Phe
                325                 330                 335

Arg Asn Ile Thr Phe Pro Met Ile Leu Ala Val Ala Ala Pro Thr Leu
            340                 345                 350

Ile Ser Gln Tyr Thr Phe Asn Phe Asn Asn Phe Ser Ile Met Tyr Leu
        355                 360                 365

Phe Asn Gly Gly Gly Pro Gly Ser Val Gly Gly Gly Ala Gly Ser Thr
    370                 375                 380

Asp Ile Leu Ile Ser Trp Ile Tyr Arg Leu Thr Thr Gly Thr Ser Pro
385                 390                 395                     400

Gln Tyr Ser Met Ala Ala Ala Val Thr Leu Ile Ile Ser Ile Ile Val
                405                 410                 415
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Ile Ser Ile Ser Met Ile Ala Phe Lys Lys Leu His Ala Phe Asp Met
420 425 430

Glu Asp Val
435

<210> 404
<211> 287
<212> PRT
<213> Streptococcus pneumoniae

<400> 404

Met Ile Trp Arg Thr Ser Lys Met Asn Asn Ser Ile Lys Leu Lys Arg
1 5 10 15

Arg Leu Thr Gln Ser Leu Thr Tyr Leu Tyr Leu Ile Gly Leu Ser Ile
20 25 30

Val Ile Ile Tyr Pro Leu Leu Ile Thr Ile Met Ser Ala Phe Lys Ala
35 40 45

Gly Asn Val Ser Ala Phe Lys Leu Asp Thr Asn Ile Asp Leu Asn Phe
50 55 60

Asp Asn Phe Lys Gly Leu Phe Thr Glu Thr Leu Tyr Gly Thr Trp Tyr
65 70 75 80

Leu Asn Thr Leu Ile Ile Ala Leu Ile Thr Met Ala Val Gln Thr Ser
85 90 95

Ile Ile Val Leu Ala Gly Tyr Ala Tyr Ser Arg Tyr Asn Phe Leu Ala
100 105 110

Arg Lys Gln Ser Leu Val Phe Phe Leu Ile Ile Gln Met Val Pro Thr
115 120 125

Met Ala Ala Leu Thr Ala Phe Phe Val Met Ala Leu Met Leu Asn Ala
130 135 140

Leu Asn His Asn Trp Phe Leu Ile Phe Leu Tyr Val Gly Gly Gly Ile
145 150 155 160

Pro Met Asn Ala Trp Leu Met Lys Gly Tyr Phe Asp Thr Val Pro Met
165 170 175

Ser Leu Asp Glu Ser Ala Lys Leu Asp Gly Ala Gly His Phe Arg Arg
180 185 190

Phe Trp Gln Ile Val Leu Pro Leu Val Arg Pro Met Val Ala Val Gln
195 200 205

Ala Leu Trp Ala Phe Met Gly Pro Phe Gly Asp Tyr Ile Leu Ser Ser
210 215 220

Phe Leu Leu Arg Glu Lys Glu Tyr Phe Thr Val Ala Val Gly Leu Gln
225 230 235 240

Thr Phe Val Asn Asn Ala Lys Asn Leu Lys Ile Ala Tyr Phe Ser Ala
245 250 255

Gly Ala Ile Leu Ile Ala Leu Pro Ile Cys Ile Leu Phe Phe Phe Leu
260 265 270

Gln Lys Asn Phe Val Ser Gly Leu Thr Ser Gly Gly Asp Lys Gly
275 280 285

<210> 405
<211> 266
<212> PRT
<213> Streptococcus pneumoniae

<400> 405

Met Leu Pro Tyr Pro Phe Ser Tyr Phe Ser Ser Ile Trp Gly Val Arg
1 5 10 15

Lys Pro Leu Ser Lys Arg Phe Glu Leu Asn Trp Phe Gln Leu Leu Phe
20 25 30

Thr Ser Ile Phe Leu Ile Ser Leu Ser Met Val Pro Ile Ala Ile Gln
35 40 45

Asn Ser Ser Gln Glu Thr Tyr Pro Leu Glu Thr Phe Ile Asp Asn Val
50 55 60

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Tyr Glu Pro Leu Thr Asp Lys Val Val Gln Asp Leu Ser Glu His Ala
65                  70                  75                  80

Thr Ile Val Asp Gly Thr Leu Thr Tyr Thr Gly Thr Ala Ser Gln Ala
                85                  90                  95

Pro Ser Val Val Ile Gly Pro Ser Gln Ile Lys Glu Leu Pro Lys Asp
            100                 105                 110

Leu Gln Leu His Phe Asp Thr Asn Glu Leu Val Ile Ser Lys Glu Ser
        115                 120                 125

Lys Glu Leu Thr Arg Ile Ser Tyr Arg Ala Ile Gln Thr Glu Ser Phe
    130                 135                 140

Lys Ser Lys Asp Ser Leu Thr Gln Ala Ile Ser Lys Asp Trp Tyr Gln
145                 150                 155                 160

Gln Asn Arg Val Tyr Ile Ser Leu Phe Leu Val Leu Gly Ala Ser Phe
                165                 170                 175

Leu Phe Gly Leu Asn Phe Phe Ile Val Ser Leu Gly Ala Ser Phe Leu
            180                 185                 190

Leu Tyr Ile Thr Lys Arg Ser Arg Leu Phe Ser Phe Asn Thr Phe Lys
        195                 200                 205

Glu Cys Tyr His Phe Ile Leu Asn Cys Leu Gly Leu Pro Thr Leu Ile
    210                 215                 220

Thr Leu Ile Leu Gly Leu Phe Gly Gln Asn Met Thr Thr Leu Ile Thr
225                 230                 235                 240

Val Gln Asn Ile Leu Phe Val Leu Tyr Leu Val Thr Ile Phe Tyr Lys
                245                 250                 255

Thr His Phe Arg Asp Pro Asn Tyr His Lys
            260                 265
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<210> 406

<211> 313
<212> PRT
<213> Streptococcus pneumoniae

<400> 406

Met Lys Gln Thr Lys Arg Ile Lys Arg Trp Arg Tyr Tyr Leu Arg Arg
1   5   10   15

Phe Ala Tyr Gln Ile Lys Ile Leu Arg Val Leu Gln Ser Ile Ser Arg
            20   25   30

Glu Lys Tyr Asp Glu Lys Ile Ser Ala Ser Leu Val Tyr Gly Phe Leu
        35   40   45

Ser Ala Val Ala Val Asn Phe Phe Phe Gln Pro Gly His Val Tyr Ser
    50   55   60

Ser Gly Ala Thr Gly Leu Ala Gln Ile Ile Ser Ala Leu Ser Asn His
65   70   75   80

Trp Phe Gly Phe His Ile Pro Ile Ser Leu Ser Phe Tyr Ala Ile Asn
                85   90   95

Phe Pro Leu Met Val Leu Ala Trp Tyr Gln Ile Gly His Lys Phe Thr
            100   105   110

Val Phe Thr Phe Ile Thr Val Ser Met Ser Ser Phe Phe Ile Gln Phe
        115   120   125

Val Pro Val Ala Thr Leu Thr Glu Asp Pro Ile Ile Asn Ser Leu Phe
    130   135   140

Gly Gly Val Val Met Gly Leu Gly Ile Gly Phe Ala Leu Arg Asn Asn
145   150   155   160

Ile Ser Ser Gly Gly Thr Asp Ile Val Ser Leu Thr Ile Arg Lys Lys
                165   170   175

Thr Gly Lys Asn Val Gly Ser Ile Ser Phe Leu Val Asn Gly Thr Ile
            180   185   190

Met Leu Ile Ala Gly Leu Thr Phe Gly Trp Lys Tyr Ala Leu Tyr Ser

195 200 205

Met Ile Thr Ile Phe Val Ser Ser Arg Val Thr Asp Ala Val Phe Thr
210 215 220

Lys Gln Lys Arg Met Gln Ala Met Ile Val Thr Asn His Pro Glu Lys
225 230 235 240

Val Ile Glu Lys Ile His Lys Lys Leu His Arg Gly Ala Thr Met Ile
245 250 255

His Asp Ala Glu Gly Thr Tyr Asn His Glu Arg Lys Ala Val Leu Ile
260 265 270

Thr Val Ile Thr Arg Ala Glu Phe Asn Glu Phe Lys Gln Ile Met Thr
275 280 285

Gln Val Asp Pro Ser Ser Phe Val Ser Val Ser Glu Asn Val His Ile
290 295 300

Leu Gly Arg Phe Val Glu Ile Asp Asn
305 310

<210> 407
<211> 76
<212> PRT
<213> Streptococcus pneumoniae

<400> 407

Met Lys Arg Val Ile Leu Leu Ala Val Ile Gln Ala Val Val Leu Phe
1 5 10 15

Phe Ile Ile Gly Ala Leu Ala Tyr Ala Phe Lys Gly Asp Phe Phe Tyr
20 25 30

Asn Tyr Leu Ala Val Val Phe Ala Pro Ile Ala Gly Val Leu Arg Phe
35 40 45

Gly Thr Ala Tyr Ile Thr Glu Ile Val Leu Pro Arg Lys Ala Ala Glu
50 55 60

Ile Ala Glu Lys Arg Lys Ala Gly Lys Asn Ser Lys

65 70 75

<210> 408
<211> 213
<212> PRT
<213> Streptococcus pneumoniae

<400> 408

Met Lys Leu Leu Lys Asn Leu Gly Trp Ile Leu Leu Ala Leu Leu Ser
1 5 10 15

Phe Leu Phe Ile Tyr Gly Phe Ile Gln Gly Leu Ala Thr Ala Ser Leu
20 25 30

Ala Leu Gly Ala Ser Pro Tyr Ala Val Thr Leu Leu Tyr Val Ala Leu
35 40 45

Ala Gly Val Tyr Val Tyr Gly Ile Tyr Lys Trp Tyr Gln Lys Ala Pro
50 55 60

Val His Ile Glu Lys Ser Gly Phe Asn Arg Phe Ile Trp Leu Pro Val
65 70 75 80

Leu Val Trp Phe Leu Ser Leu Val Val Gln Phe Phe Leu Pro Asp Asp
85 90 95

Pro Ser Val Asn Gln Gln Ile Ala Thr Asp Leu Thr Leu Ser Gln Pro
100 105 110

Leu Phe Ser Phe Phe Ala Val Val Ile Phe Ala Pro Leu Thr Glu Glu
115 120 125

Ile Val Phe Arg Gly Met Leu Ala Arg Tyr Leu Phe Pro Lys Gln Asp
130 135 140

Asn Ser Lys Arg Thr Leu Ile Phe Leu Leu Val Ser Ser Leu Leu Phe
145 150 155 160

Ala Leu Ile His Phe Pro Gly Asp Val Gln Gln Phe Phe Val Tyr Phe
165 170 175

Ser Leu Gly Phe Ser Leu Gly Leu Ala Tyr Ile Ser Arg Lys Gly Leu

180 185 190

Val Tyr Ser Ile Ser Leu His Ala Leu Asn Asn Leu Val Gly Phe Leu
195 200 205

Met Ile Leu Met Leu
210

<210> 409
<211> 226
<212> PRT
<213> Streptococcus pneumoniae

<400> 409

Met Gly Met Phe Val Gly Met Phe Lys Ala Arg Val Glu Ser His Glu
1 5 10 15

Ile Ile Leu Asp Val Lys Ala Leu Met Pro Trp Ile Ser Ala Ile Cys
20 25 30

Leu Leu Ile Gly Phe Ile Ser Met Phe Leu Thr Phe Asn Phe Leu Lys
35 40 45

Lys Ser Arg Lys Phe His Ser Leu Tyr Gln Glu Glu Met Asp Asp Asp
50 55 60

Leu Asn Glu Thr Tyr Tyr Val Gln Met Tyr Arg Asn Leu Glu Phe Gly
65 70 75 80

Thr Ile Ala Phe Asn Ile Thr Gly Val Ala Ile Pro Leu Ala Ile Phe
85 90 95

Ile Ser Leu Ser Glu Val Ile Ile Leu His Thr Asn Pro Gln Thr Phe
100 105 110

Phe Leu Ser Phe Leu Leu Phe Val Val Phe Leu Val Ala Gln Lys Ser
115 120 125

Leu Phe Lys Thr Ile Ala Ile Val Arg Gln Phe Asp Leu Glu Phe Phe
130 135 140

Ala Thr Pro Lys Asp Val Leu Asn Tyr Ile Asn Ser Tyr Asp Glu Gly

145 150 155 160

Glu Arg Gln Ala Asn Leu Glu Gln Ser Phe Arg Ile Leu Phe Gln Leu
165 170 175

His Gln Tyr Val Leu Pro Ala Leu Tyr Ile Phe Leu Ile Ile Ile Ser
180 185 190

Phe Leu Thr Gly Glu Ile Gln Leu Leu Ala Phe Leu Leu Val Gly Ala
195 200 205

Ile His Val Tyr Ile Asn Val Met Gln Leu Pro Met Val Lys Arg Tyr
210 215 220

Phe Lys
225

<210> 410
<211> 621
<212> PRT
<213> Streptococcus pneumoniae

<400> 410

Met Lys Lys Thr Thr Ile Leu Ser Leu Thr Thr Ala Ala Val Ile Leu
1 5 10 15

Ala Ala Tyr Val Pro Asn Glu Pro Ile Leu Ala Asp Thr Pro Ser Ser
20 25 30

Glu Val Ile Lys Glu Thr Lys Val Gly Ser Ile Ile Gln Gln Asn Asn
35 40 45

Ile Lys Tyr Lys Val Leu Thr Val Glu Gly Asn Ile Gly Thr Val Gln
50 55 60

Val Gly Asn Gly Val Thr Pro Val Glu Phe Glu Ala Gly Gln Asp Gly
65 70 75 80

Lys Pro Phe Thr Ile Pro Thr Lys Ile Thr Val Gly Asp Lys Val Phe
85 90 95

Thr Val Thr Glu Val Ala Ser Gln Ala Phe Ser Tyr Tyr Pro Asp Glu

100 105 110

Thr Gly Arg Ile Val Tyr Tyr Pro Ser Ser Ile Thr Ile Pro Ser Ser
115 120 125

Ile Lys Lys Ile Gln Lys Lys Gly Phe His Gly Ser Lys Ala Lys Thr
130 135 140

Ile Ile Phe Asp Lys Gly Ser Gln Leu Glu Lys Ile Glu Asp Arg Ala
145 150 155 160

Phe Asp Phe Ser Glu Leu Glu Glu Ile Glu Leu Pro Ala Ser Leu Glu
165 170 175

Tyr Ile Gly Thr Ser Ala Phe Ser Phe Ser Gln Lys Leu Lys Lys Leu
180 185 190

Thr Phe Ser Ser Ser Ser Lys Leu Glu Leu Ile Ser His Glu Ala Phe
195 200 205

Ala Asn Leu Ser Asn Leu Glu Lys Leu Thr Leu Pro Lys Ser Val Lys
210 215 220

Thr Leu Gly Ser Asn Leu Phe Arg Leu Thr Thr Ser Leu Lys His Val
225 230 235 240

Asp Val Glu Glu Gly Asn Glu Ser Phe Ala Ser Val Asp Gly Val Leu
245 250 255

Phe Ser Lys Asp Lys Thr Gln Leu Ile Tyr Tyr Pro Ser Gln Lys Asn
260 265 270

Asp Glu Ser Tyr Lys Thr Pro Lys Glu Thr Lys Glu Leu Ala Ser Tyr
275 280 285

Ser Phe Asn Lys Asn Ser Tyr Leu Lys Lys Leu Glu Leu Asn Glu Gly
290 295 300

Leu Glu Lys Ile Gly Thr Phe Ala Phe Ala Asp Ala Ile Lys Leu Glu
305 310 315 320

Glu Ile Ser Leu Pro Asn Ser Leu Glu Thr Ile Glu Arg Leu Ala Phe
325 330 335

Tyr Gly Asn Leu Glu Leu Lys Glu Leu Ile Leu Pro Asp Asn Val Lys
340 345 350

Asn Phe Gly Lys His Val Met Asn Gly Leu Pro Lys Leu Lys Ser Leu
355 360 365

Thr Ile Gly Asn Asn Ile Asn Ser Leu Pro Ser Phe Phe Leu Ser Gly
370 375 380

Val Leu Asp Ser Leu Lys Glu Ile His Ile Lys Asn Lys Ser Thr Glu
385 390 395 400

Phe Ser Val Lys Lys Asp Thr Phe Ala Ile Pro Glu Thr Val Lys Phe
405 410 415

Tyr Val Thr Ser Glu His Ile Lys Asp Val Leu Lys Ser Asn Leu Ser
420 425 430

Thr Ser Asn Asp Ile Ile Val Glu Lys Val Asp Asn Ile Lys Gln Glu
435 440 445

Thr Asp Val Ala Lys Pro Lys Lys Asn Ser Asn Gln Gly Val Val Gly
450 455 460

Trp Val Lys Asp Lys Gly Leu Trp Tyr Tyr Leu Asn Glu Ser Gly Ser
465 470 475 480

Met Ala Thr Gly Trp Val Lys Asp Lys Gly Leu Trp Tyr Tyr Leu Asn
485 490 495

Glu Ser Gly Ser Met Ala Thr Gly Trp Val Lys Asp Lys Gly Leu Trp
500 505 510

Tyr Tyr Leu Asn Glu Ser Gly Ser Met Ala Thr Gly Trp Val Lys Asp
515 520 525

Lys Gly Leu Trp Tyr Tyr Leu Asn Glu Ser Gly Ser Met Ala Thr Gly
530 535 540

Trp Val Lys Asp Lys Gly Leu Trp Tyr Tyr Leu Asn Glu Ser Gly Ser
545 550 555 560

Met Ala Thr Gly Trp Val Lys Asp Lys Gly Leu Trp Tyr Tyr Leu Asn
565 570 575

Glu Ser Gly Ser Met Ala Thr Gly Trp Val Thr Val Ser Gly Lys Trp
580 585 590

Tyr Tyr Thr Tyr Asn Ser Gly Asp Leu Leu Val Asn Thr Thr Thr Pro
595 600 605

Asp Gly Tyr Arg Val Asn Ala Asn Gly Glu Trp Val Gly
610 615 620

<210> 411
<211> 383
<212> PRT
<213> Streptococcus pneumoniae

<400> 411

Met Ala Ile Phe Tyr Val Pro Ala Val Asn Leu Ile Gly Lys Gly Val
1 5 10 15

Val Asn Glu Val Gly Pro Tyr Ile Lys Glu Leu Gly Tyr Lys Lys Ala
20 25 30

Leu Leu Val Thr Asp Lys Tyr Ile Glu Gly Ser Asp Ile Leu Pro Lys
35 40 45

Thr Leu Lys Pro Leu Asp Thr Glu Gly Ile Glu Tyr Val Ile Phe Ser
50 55 60

Asp Val Glu Pro Asn Pro Thr Cys Lys Asn Val Thr Asp Gly Val Ala
65 70 75 80

Ala Leu Gln Glu His Gly Cys Asp Phe Ile Ile Ser Leu Gly Gly Gly
85 90 95

Ser Pro Gln Asp Ala Ala Ser Cys Ile Ser Ile Met Ala Thr Asn Gly
100 105 110

Gly Lys Pro Gln Asp Tyr Glu Gly Leu His Lys Ser Ala Lys Lys Gly
115 120 125

Leu Pro Val Val Ala Ile Asn Thr Thr Ala Gly Thr Ser Ala Glu Ile
130 135 140

Thr Ile Asn Tyr Val Ile Thr Asp Glu Glu Arg Lys Val Lys Met Val
145 150 155 160

Met Val Asp Lys Asn Ser Leu Ala Leu Ile Ser Val Asn Asp Pro Glu
165 170 175

Leu Met Leu Ser Lys Pro Lys Gly Leu Thr Ala Ala Thr Gly Met Asp
180 185 190

Ala Leu Thr His Ala Val Glu Ala Leu Val Thr Pro Gly Ala Tyr Asp
195 200 205

Val Thr Lys Lys Leu Ser Ile Gly Ala Ile Glu Leu Ile Lys Glu Tyr
210 215 220

Leu Pro Arg Ala Val Glu Asn Gly His Asp Ile Glu Ala Arg Glu Gly
225 230 235 240

Met Val Asn Ala Ile Phe Leu Gly Gly Met Ser Phe Asn Asn Ala Gly
245 250 255

Leu Gly Tyr Val His Ser Met Ala His Gln Leu Gly Ala Val Tyr Asn
260 265 270

Leu Pro His Gly Val Cys Cys Ala Met Leu Leu Pro Val Ile Glu Arg
275 280 285

Glu Asn Ala Lys Arg Val Pro Glu Ala Phe Arg Asn Val Ala Lys Ala
290 295 300

Leu Gly Leu His Val Glu Gly Lys Ser Asp Gln Glu Cys Ala Asp Tyr
305 310 315 320

Ala Ile Ala Glu Ile Glu Lys Leu Ser Glu Thr Val Gly Ile Pro Lys
325 330 335

Lys Leu Thr Glu Leu Gly Ile Glu Glu Lys Asp Phe Asp Phe Glu Tyr
340 345 350

Leu Ser Lys Asn Ala Leu Ile Asp Ala Cys Ala Pro Gly Asn Pro Phe
355 360 365

Met Pro Thr Leu Glu Glu Thr Ile Ala Phe Tyr Lys Glu Leu Phe
370 375 380

<210> 412
<211> 257
<212> PRT
<213> Streptococcus pneumoniae

<400> 412

Met Ile Lys Asp Glu Arg Val Leu Glu Leu Ile Glu Ile Ile Lys Lys
1 5 10 15

Lys Lys Arg Ile Ala Val Lys Glu Leu Ala Glu Ile Thr Phe Ser Ser
20 25 30

Thr Ser Thr Leu Arg Arg Asp Leu Ile Phe Leu Glu Asn Gln Gly Leu
35 40 45

Ile Lys Arg Lys His Gly Tyr Val Thr Leu Ser Ser Met Asn Thr Ile
50 55 60

Glu Leu Ser His Gln Ile Arg Glu Gly Glu Ser Thr Arg Gln Lys Arg
65 70 75 80

Leu Ile Ala Ser Leu Ala Lys Asp Phe Ile Arg Ser Gly Met Cys Ile
85 90 95

Tyr Leu Asp Ser Ser Thr Thr Val Tyr Glu Leu Cys Pro Tyr Leu Ser
100 105 110

Glu Leu Asp Asn Leu Ile Ile Phe Thr Asn Gly Leu His Thr Ala Gln
115 120 125

Thr Leu Ser Glu Thr Val Lys Asp Ser Ser Lys Ile Phe Ile Thr Ser
130 135 140

Gly Glu Val Lys His Gln Ser Cys Ser Val Val Asn Tyr Asp Lys Glu
145 150 155 160

Asn Ser Leu Leu Asp His Phe Asn Ile Asp Leu Ala Phe Cys Ser Ala
165 170 175

Arg Gly Ile Asp Asp Gln Tyr Val Tyr Glu Ala Ser Leu Ser Gln Ala
180 185 190

Ile Ser Lys Lys Asn Ile Ile Asp Lys Ala His Glu Thr Ile Leu Leu
195 200 205

Ile Asp Ser Ser Lys Phe Tyr Lys Thr Gly Phe Phe Lys Ile Asn Pro
210 215 220

Leu Ser Lys Tyr Thr Thr Phe Ile Ser Asp Thr Val Pro Asp Gln Lys
225 230 235 240

Leu Leu Asp Ala Val Glu Leu Phe Asp Gly Glu Trp Val Ser Asp Ile
245 250 255

Gln

<210> 413
<211> 268
<212> PRT
<213> Streptococcus pneumoniae

<400> 413

Met Leu Ser Leu Leu Ser Tyr Asp Phe Ile Gln Arg Ala Phe Leu Ala
1 5 10 15

Val Ile Ala Met Ser Leu Phe Ser Pro Val Leu Gly Thr Phe Leu Ile
20 25 30

Leu Arg Arg Gln Ser Leu Met Ser Asp Thr Leu Ser His Val Ser Leu
35 40 45

Ser Gly Val Ala Phe Gly Leu Val Leu Gly Ile Ser Pro Thr Val Ser
50 55 60

Thr Ile Ala Ile Val Leu Ile Ala Ala Val Phe Leu Glu Tyr Leu Arg
65 70 75 80

Thr Val Tyr Lys Ser Phe Met Glu Ile Gly Thr Ala Ile Leu Met Ser
85 90 95

Thr Gly Leu Ala Val Ser Leu Ile Val Met Ser Lys Gly Lys Ser Ser
100 105 110

Ser Ser Met Ser Leu Asp Gln Tyr Leu Phe Gly Ser Ile Val Thr Ile
115 120 125

Ser Glu Glu Gln Val Ile Ser Leu Phe Val Ile Ala Ala Val Val Leu
130 135 140

Ile Leu Thr Phe Leu Phe Leu Arg Pro Met Tyr Ile Leu Thr Phe Asp
145 150 155 160

Glu Asp Thr Ala Phe Val Asp Gly Leu Pro Val Arg Thr Met Ser Ile
165 170 175

Leu Phe Asn Met Val Thr Gly Val Ala Ile Ala Leu Met Ile Pro Ala
180 185 190

Ala Gly Ala Leu Leu Val Ser Thr Ile Met Val Leu Pro Ala Ser Ile
195 200 205

Ala Leu Arg Leu Gly Lys Asn Phe Lys Ser Val Met Leu Leu Ala Ser
210 215 220

Ala Ile Gly Phe Leu Gly Met Val Ala Gly Leu Tyr Ile Ser Tyr Tyr
225 230 235 240

Ala Glu Thr Pro Ala Ser Ala Ser Ile Thr Ile Ile Phe Val Thr Val
245 250 255

Phe Ile Leu Ile Ser Leu Val Arg Arg Phe Ile Lys
260 265

<210> 414

<211> 234
<212> PRT
<213> Streptococcus pneumoniae

<400> 414

Met Arg Tyr Ile Thr Val Glu Asp Leu Ser Phe Tyr Tyr Asp Lys Glu
1 5 10 15

Pro Val Leu Glu His Ile Asn Tyr Cys Val Asp Ser Gly Glu Phe Val
20 25 30

Thr Leu Thr Gly Glu Asn Gly Ala Ala Lys Thr Thr Leu Ile Lys Ala
35 40 45

Ser Leu Gly Ile Leu Gln Pro Arg Ile Gly Lys Val Ala Ile Ser Lys
50 55 60

Thr Asn Thr Gln Gly Lys Lys Leu Arg Ile Ala Tyr Leu Pro Gln Gln
65 70 75 80

Ile Ala Ser Phe Asn Ala Gly Phe Pro Ser Thr Val Tyr Glu Phe Val
85 90 95

Lys Ser Gly Arg Tyr Pro Arg Lys Gly Trp Phe Arg Arg Leu Asn Ala
100 105 110

His Asp Glu Glu His Ile Lys Ala Ser Leu Asp Ser Val Gly Met Trp
115 120 125

Glu His Arg Asp Lys Arg Leu Gly Ser Leu Ser Gly Gly Gln Lys Gln
130 135 140

Arg Ala Val Ile Ala Arg Met Phe Ala Ser Asp Pro Asp Val Phe Ile
145 150 155 160

Leu Asp Glu Pro Thr Thr Gly Met Asp Ala Gly Ser Lys Asn Glu Phe
165 170 175

Tyr Glu Leu Met His His Ser Ala His His His Gly Lys Ala Val Leu
180 185 190

Met Ile Thr His Asp Pro Glu Glu Val Lys Asp Tyr Ala Asp Arg Asn

195 200 205

Ile His Leu Val Arg Asn Gln Asp Ser Pro Trp Arg Cys Phe Asn Val
210 215 220

His Glu Asn Gly Gln Glu Val Gly His Ala
225 230

<210> 415
<211> 516
<212> PRT
<213> Streptococcus pneumoniae

<400> 415

Met Ser Asn Lys Pro Ile Ala Asp Met Ile Glu Thr Ile Glu His Phe
1 5 10 15

Ala Gln Thr Gln Pro Ser Tyr Pro Val Tyr Asn Val Leu Gly Gln Glu
20 25 30

His Thr Tyr Gly Asp Leu Lys Ala Asp Ser Asp Ser Leu Ala Ala Val
35 40 45

Ile Asp Gln Leu Gly Leu Pro Glu Lys Ser Pro Val Val Val Phe Gly
50 55 60

Gly Gln Glu Tyr Glu Met Leu Ala Thr Phe Val Ala Leu Thr Lys Ser
65 70 75 80

Gly His Ala Tyr Ile Pro Ile Asp Ser His Ser Ala Leu Glu Arg Val
85 90 95

Ser Ala Ile Leu Glu Val Ala Glu Pro Ser Leu Ile Ile Ala Ile Ser
100 105 110

Ala Phe Pro Leu Glu Gln Val Ser Thr Pro Met Ile Asn Leu Ala Gln
115 120 125

Val Gln Glu Ala Phe Ala Gln Gly Asn Asn Tyr Glu Ile Thr His Pro
130 135 140

Val Lys Gly Asp Asp Asn Tyr Tyr Ile Ile Phe Thr Ser Gly Thr Thr

145 150 155 160

Gly Lys Pro Lys Gly Val Gln Ile Ser His Asp Asn Leu Leu Ser Phe
165 170 175

Thr Asn Trp Met Ile Thr Asp Lys Glu Phe Ala Thr Pro Ser Arg Pro
180 185 190

Gln Met Leu Ala Gln Pro Pro Tyr Ser Phe Asp Leu Ser Val Met Tyr
195 200 205

Trp Ala Pro Thr Leu Ala Leu Gly Gly Thr Leu Phe Thr Leu Pro Ser
210 215 220

Val Ile Thr Gln Asp Phe Lys Gln Leu Phe Ala Ala Ile Phe Ser Leu
225 230 235 240

Pro Ile Ala Ile Trp Thr Ser Thr Pro Ser Phe Ala Asp Met Ala Met
245 250 255

Leu Ser Glu Tyr Phe Asn Ser Glu Lys Met Pro Gly Ile Thr His Phe
260 265 270

Tyr Phe Asp Gly Glu Glu Leu Thr Val Lys Thr Ala Gln Lys Leu Arg
275 280 285

Glu Arg Phe Pro Asn Ala Arg Ile Ile Asn Ala Tyr Gly Pro Thr Glu
290 295 300

Ala Thr Val Ala Leu Ser Ala Val Ala Val Thr Asp Glu Met Leu Ala
305 310 315 320

Thr Leu Lys Arg Leu Pro Ile Gly Tyr Thr Lys Ala Asp Ser Pro Thr
325 330 335

Phe Ile Ile Asp Glu Glu Gly Asn Lys Leu Pro Asn Gly Glu Gln Gly
340 345 350

Glu Ile Ile Val Ser Gly Pro Ala Val Ser Lys Gly Tyr Met Asn Asn
355 360 365

Pro Glu Lys Thr Ala Glu Ala Phe Phe Glu Phe Glu Asp Leu Pro Ala
370 375 380

Tyr His Thr Gly Asp Val Gly Thr Met Thr Asp Glu Gly Leu Leu Leu
385 390 395 400

Tyr Gly Gly Arg Met Asp Phe Gln Ile Lys Phe Asn Gly Tyr Arg Ile
405 410 415

Glu Leu Glu Asp Val Ser Gln Asn Leu Asn Lys Ser Arg Phe Ile Glu
420 425 430

Ser Ala Val Ala Val Pro Arg Tyr Asn Lys Asp His Lys Val Gln Asn
435 440 445

Leu Leu Ala Tyr Val Ile Leu Lys Asp Gly Val Arg Glu Gln Phe Glu
450 455 460

Arg Asp Ile Asp Ile Thr Lys Ala Ile Lys Glu Asp Leu Thr Asp Ile
465 470 475 480

Met Met Ser Tyr Met Met Pro Ser Lys Phe Leu Tyr Arg Asp Ser Leu
485 490 495

Pro Leu Thr Pro Asn Gly Lys Ile Asp Ile Lys Gly Leu Ile Asn Glu
500 505 510

Val Asn Lys Arg
515

<210> 416
<211> 131
<212> PRT
<213> Streptococcus pneumoniae

<400> 416

Met Met Ser Leu Val His Asn Ile Ile Glu Asp Gly Asp Thr Glu Ser
1 5 10 15

Leu Ile Arg Lys Tyr Leu His Ser Gly Val Ile Ile Asn Gly Gln Arg
20 25 30

Tyr Lys Thr Leu Val Gly Thr Pro Gln Gly Gly Asn Leu Ser Pro Leu
35 40 45

Leu Ser Asn Ile Met Leu Asn Glu Leu Asp Lys Glu Leu Glu Lys Arg
50 55 60

Gly Leu Arg Phe Val Arg Tyr Ala Asp Asp Cys Val Ile Thr Val Gly
65 70 75 80

Ser Glu Ala Ala Ser Lys Arg Val Met Tyr Ser Val Ser Arg Phe Ile
85 90 95

Glu Lys Arg Leu Gly Leu Lys Val Asn Met Thr Lys Arg Val Glu Ile
100 105 110

Ser Arg Phe Trp Val Leu Glu Ile Ile Arg Trp Leu Glu Lys Pro Ser
115 120 125

Thr Ser Arg
130

<210> 417
<211> 137
<212> PRT
<213> Streptococcus pneumoniae

<400> 417

Met Ser Lys Leu Leu Asp Lys Ile Leu Ser Arg Glu Asn Met Leu Glu
1 5 10 15

Ala Tyr Asn Gln Val Lys Ser Asn Lys Gly Ser Ala Gly Ile Asp Gly
20 25 30

Met Thr Ile Glu Glu Met Asp Asn Tyr Leu Arg Gln Asn Trp Arg Leu
35 40 45

Thr Lys Glu Leu Ile Lys Gln Arg Lys Tyr Lys Pro Gln Pro Val Leu
50 55 60

Arg Val Glu Ile Pro Lys Pro Asp Gly Gly Ile Arg Gln Leu Gly Ile
65 70 75 80

```
Pro Thr Val Met Asp Arg Met Ile Gln Gln Ala Ile Val Gln Val Met
                85                  90                  95

Ser Pro Ile Cys Glu Pro His Phe Ser Asp Thr Ser Tyr Gly Phe Arg
            100                 105                 110

Pro Asn Arg Ser Cys Glu Lys Ala Ile Met Lys Leu Leu Glu Tyr Leu
        115                 120                 125

Asn Asp Gly Tyr Glu Trp Ile Val Asp
    130                 135

<210>  418
<211>  164
<212>  PRT
<213>  Streptococcus pneumoniae

<400>  418

Met Arg Gln Leu Lys Arg Val Gly Val Phe Leu Leu Leu Pro Phe Phe
1               5                   10                  15

Val Leu Ile Asp Ala His Ile Ser Gln Leu Leu Gly Ser Phe Phe Pro
            20                  25                  30

His Val His Leu Ala Ser His Phe Leu Phe Leu Phe Leu Leu Phe Glu
        35                  40                  45

Thr Ile Glu Val Ser Glu Tyr Leu Tyr Leu Val Tyr Cys Phe Val Ile
    50                  55                  60

Gly Leu Val Tyr Asp Val Tyr Phe Phe His Leu Ile Gly Ile Thr Thr
65                  70                  75                  80

Leu Leu Phe Ile Leu Leu Gly Ala Phe Leu His Lys Leu Asn Ser Val
                85                  90                  95

Ile Leu Leu Asn Arg Trp Thr Arg Met Leu Ala Met Ile Val Leu Thr
            100                 105                 110

Phe Leu Phe Glu Met Gly Ser Tyr Leu Leu Ala Phe Met Val Gly Leu
        115                 120                 125
```

Thr Val Asp Ser Met Ser Ile Phe Ile Val Tyr Ser Leu Val Pro Thr
    130   135   140

Met Ile Leu Asn Phe Leu Trp Ile Thr Val Phe Gln Phe Ile Phe Glu
145   150   155   160

Lys Tyr Tyr Leu

<210> 419
<211> 427
<212> PRT
<213> Streptococcus pneumoniae

<400> 419

Met Thr Lys Val Val Phe Glu Glu Lys Tyr Tyr Pro Ala Val Lys Glu
1   5   10   15

Met Val Tyr Arg Thr Arg Leu Ala Asn Gly Leu Thr Val Ala Leu Leu
            20   25   30

Pro Lys Lys Glu Phe Lys Glu Val Tyr Gly Ser Val Thr Val Gln Phe
        35   40   45

Gly Ser Val Asp Thr Phe Val Thr Glu Val Asp Gly Asp Val Lys Gln
    50   55   60

Tyr Pro Gly Gly Ile Ala His Phe Leu Glu His Lys Leu Phe Glu Arg
65   70   75   80

Glu Asp Ser Ser Asp Leu Met Ser Ala Phe Thr Ser Leu Gly Ala Asp
                85   90   95

Ser Asn Ala Phe Thr Ser Phe Thr Lys Thr Asn Tyr Leu Phe Ser Ala
            100   105   110

Thr Asp Tyr Phe Leu Glu Asn Leu Asp Leu Leu Asp Glu Leu Val Thr
        115   120   125

Ser Ala His Phe Thr Glu Ala Ser Ile Leu Thr Glu Gln Asp Ile Ile
    130   135   140

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Gln Gln Glu Arg Glu Met Tyr Gln Asp Asp Pro Asp Ser Cys Leu Phe
145                 150                 155                 160

Phe Ser Thr Leu Ala Asn Leu Tyr Pro Gly Thr Pro Leu Ala Thr Asp
                165                 170                 175

Ile Val Gly Ser Glu Glu Ser Ile Ser Gln Ile Asn Leu Thr Asn Leu
            180                 185                 190

Gln Glu Asn Phe Thr Lys Phe Tyr Lys Pro Val Asn Met Ser Leu Phe
        195                 200                 205

Leu Val Gly Asn Phe Asp Val Glu Arg Val Gln Asp Tyr Phe Glu Ser
    210                 215                 220

Lys Glu Leu Lys Asp Ser Asp Phe Gln Glu Val Ala Arg Glu Lys Leu
225                 230                 235                 240

Phe Leu Gln Pro Val Lys Pro Thr Asp Ser Met Arg Met Glu Val Ser
                245                 250                 255

Ser Pro Lys Leu Ala Ile Gly Val Arg Gly Lys Arg Glu Val Ser Glu
            260                 265                 270

Ala Asp Cys Tyr Arg His His Ile Leu Leu Lys Leu Leu Phe Ala Met
        275                 280                 285

Met Phe Gly Trp Thr Ser Asp Arg Phe Gln Lys Cys Tyr Glu Ser Gly
    290                 295                 300

Lys Ile Asp Ala Ser Leu Ser Leu Glu Val Glu Ile Thr Ser Arg Phe
305                 310                 315                 320

His Phe Val Met Leu Thr Met Asp Thr Lys Glu Pro Val Ala Leu Ser
                325                 330                 335

His Gln Phe Arg Lys Ala Ile Arg Asn Phe Thr Lys Asp Leu Asp Ile
            340                 345                 350

Thr Glu Glu His Leu Asp Ile Ile Lys Arg Glu Met Phe Gly Glu Phe
        355                 360                 365
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Phe Ser Ser Met Asn Ser Leu Glu Phe Ile Ala Thr Gln Tyr Asp Ala
    370                 375                 380

Phe Glu Asn Gly Glu Ile Ile Phe Asp Leu Pro Lys Ile Leu Gln Glu
385                 390                 395                 400

Ile Thr Leu Glu Asp Val Leu Asp Ala Gly His His Leu Ile Asp Asp
                405                 410                 415

Gly Asp Ile Val Asp Phe Thr Ile Phe Pro Ser
            420                 425


<210>  420
<211>  540
<212>  PRT
<213>  Streptococcus pneumoniae

<400>  420

Met Leu Thr Val Ser Asp Val Ser Leu Arg Phe Ser Asp Arg Lys Leu
1               5                   10                  15

Phe Asp Asp Val Asn Ile Lys Phe Thr Glu Gly Asn Thr Tyr Gly Leu
            20                  25                  30

Ile Gly Ala Asn Gly Ala Gly Lys Ser Thr Phe Leu Lys Ile Leu Ala
        35                  40                  45

Gly Asp Ile Glu Pro Thr Thr Gly His Ile Ser Leu Gly Pro Asp Glu
    50                  55                  60

Arg Leu Ser Val Leu Arg Gln Asn His Phe Asp Tyr Glu Asp Glu Arg
65                  70                  75                  80

Ala Ile Asp Val Val Ile Met Gly Asn Glu Lys Leu Tyr Ser Ile Met
                85                  90                  95

Lys Glu Lys Asp Ala Ile Tyr Met Lys Glu Asp Phe Ser Asp Glu Asp
            100                 105                 110

Gly Val Arg Ala Ala Glu Leu Glu Gly Glu Phe Ala Glu Leu Gly Gly
        115                 120                 125
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Trp Glu Ala Glu Ser Glu Ala Ser Gln Leu Leu Gln Asn Leu Asn Ile
130 135 140

Pro Glu Glu Leu His Tyr Gln Asn Met Ser Glu Leu Ala Asn Gly Glu
145 150 155 160

Lys Val Lys Val Leu Leu Ala Lys Ala Leu Phe Gly Lys Pro Asp Val
165 170 175

Leu Leu Leu Asp Glu Pro Thr Asn Gly Leu Asp Ile Gln Ser Ile Thr
180 185 190

Trp Leu Glu Asp Phe Leu Ile Asp Phe Asp Asn Thr Val Ile Val Val
195 200 205

Ser His Asp Arg His Phe Leu Asn Lys Val Cys Thr His Met Ala Asp
210 215 220

Leu Asp Phe Gly Lys Ile Lys Leu Tyr Val Gly Asn Tyr Asp Phe Trp
225 230 235 240

Lys Glu Ser Ser Glu Leu Ala Ala Lys Leu Leu Ala Asp Arg Asn Ala
245 250 255

Lys Ala Glu Glu Lys Ile Lys Gln Leu Gln Glu Phe Val Ala Arg Phe
260 265 270

Ser Ala Asn Ala Ser Lys Ser Arg Gln Ala Thr Ser Arg Lys Lys Met
275 280 285

Leu Asp Lys Ile Glu Leu Glu Glu Ile Val Pro Ser Ser Arg Lys Tyr
290 295 300

Pro Phe Ile Asn Phe Lys Ala Glu Arg Glu Ile Gly Asn Asp Leu Leu
305 310 315 320

Thr Val Glu Asn Leu Thr Val Lys Ile Asp Gly Glu Thr Ile Leu Asp
325 330 335

Asn Ile Ser Phe Ile Leu Arg Pro Asp Asp Lys Thr Ala Leu Ile Gly
340 345 350

Gln Asn Asp Ile Gln Thr Thr Ala Leu Ile Arg Ala Ile Met Gly Asp
355 360 365

Ile Asp Tyr Glu Gly Thr Val Lys Trp Gly Val Thr Thr Ser Gln Ser
370 375 380

Tyr Leu Pro Lys Asp Asn Ser Ala Asp Phe Ala Gly Gly Glu Ser Ile
385 390 395 400

Leu Asp Trp Leu Arg Gln Phe Ala Ser Lys Glu Glu Asp Asp Asn Thr
405 410 415

Phe Leu Arg Gly Phe Leu Gly Arg Met Leu Phe Ser Gly Asp Glu Val
420 425 430

Asn Lys Pro Val Asn Val Leu Ser Gly Gly Glu Lys Val Arg Val Met
435 440 445

Leu Ser Lys Leu Met Leu Leu Lys Ser Asn Val Leu Val Leu Asp Asp
450 455 460

Pro Thr Asn His Leu Asp Leu Glu Ser Ile Ser Ser Leu Asn Asp Gly
465 470 475 480

Leu Lys Asn Phe Lys Glu Ser Ile Ile Phe Ala Ser His Asp His Glu
485 490 495

Phe Ile Gln Thr Leu Ala Asn His Ile Ile Val Leu Ser Lys Asn Gly
500 505 510

Val Ile Asp Arg Ile Asp Glu Thr Tyr Asp Glu Phe Leu Glu Asn Ala
515 520 525

Glu Val Gln Ala Lys Val Lys Glu Leu Trp Lys Asp
530 535 540

<210> 421
<211> 850
<212> PRT
<213> Streptococcus pneumoniae

<400> 421

Met Lys Ser Phe Leu Lys Thr Tyr Arg Thr Tyr Phe Ile Ser Phe Ile
1 5 10 15

Ile Pro Val Val Ile Met Ser Gly Val Tyr Leu Ser Gln Ser Ile Tyr
20 25 30

Trp Asn Ser Asp Asn Ser Pro Leu Leu Gly Asp Gly Phe His Gln Tyr
35 40 45

Val Ile Phe Asp Val Ala Leu Arg Asn Ile Leu His Gly Asn Ser Asn
50 55 60

Leu Phe Tyr Thr Phe Thr Ser Gly Leu Gly Leu Asn Phe Tyr Ala Leu
65 70 75 80

Ser Ser Tyr Tyr Leu Gly Ser Phe Leu Ala Pro Leu Val Tyr Phe Phe
85 90 95

Asp Leu Thr Asn Met Pro Asp Ala Ile Tyr Leu Thr Thr Leu Leu Lys
100 105 110

Phe Gly Leu Ile Gly Leu Ser Thr Phe Phe Ser Leu Asn Lys Leu Phe
115 120 125

Gln Ser Ile Pro Gln Ile Leu Lys Leu Ala Leu Ser Thr Ser Tyr Ala
130 135 140

Leu Met Ser Phe Thr Val Ser Gln Leu Glu Ile Lys Thr Trp Leu Asp
145 150 155 160

Val Phe Ile Leu Ile Pro Leu Ile Ile Thr Gly Leu His Leu Leu Ile
165 170 175

Thr Glu Lys Lys Leu Leu Leu Tyr Phe Thr Ser Leu Ser Ile Leu Phe
180 185 190

Ile Gln Asn Tyr Tyr Phe Gly Tyr Met Thr Val Leu Phe Leu Ile Phe
195 200 205

Trp Tyr Leu Cys Gln Ile Ser Trp Asp Phe Lys Thr Arg Lys Ser Ser

210 215 220

Val Leu Asp Phe Ile Val Ile Ser Phe Leu Ala Gly Met Ala Ser Leu
225 230 235 240

Ile Met Thr Leu Pro Thr Leu Phe Asp Leu Gln Thr His Gly Glu Lys
245 250 255

Leu Thr Glu Val Thr Lys Phe Gln Thr Glu Ser Ser Trp Tyr Leu Asp
260 265 270

Leu Phe Ala Lys Gln Phe Ile Gly Ser Phe Asp Thr Thr Lys Tyr Gly
275 280 285

Ala Ile Pro Met Ile Phe Val Gly Leu Phe Pro Phe Ile Leu Thr Ile
290 295 300

Leu Phe Phe Thr Leu Lys Ser Ile Lys Phe His Val Lys Leu Ile Tyr
305 310 315 320

Val Ile Phe Phe Ala Phe Leu Ile Ala Ser Phe Tyr Ile Glu Ala Leu
325 330 335

Asp Leu Phe Trp Gln Gly Met His Thr Pro Asn Met Phe Leu His Arg
340 345 350

Tyr Ala Trp Ile Phe Ser Thr Leu Leu Ile Tyr Thr Ala Ala Glu Val
355 360 365

Leu Lys Arg Leu Lys Glu Leu Lys Val Trp Asn Phe Leu Val Ser Leu
370 375 380

Phe Leu Val Val Ala Gly Phe Leu Ala Thr Ile Tyr Leu Lys Ser His
385 390 395 400

Tyr Ser Phe Leu Thr Asp Leu Asn Ile Leu Leu Thr Leu Glu Phe Leu
405 410 415

Val Val Tyr Ser Leu Leu Leu Leu Ala Val Ile Lys Lys Phe Ile Ser
420 425 430

Val Asn Leu Phe Ala Ile Leu Ile Ser Leu Phe Ile Leu Val Glu Met
435 440 445

Ser Leu Asn Ala Ser Ser Gln Met Asp Gly Ile Ala Lys Glu Trp Gly
450 455 460

Phe Ala Ser Arg Ser Ala Tyr Ser Arg Asp Ile Pro Ala Met Glu Ser
465 470 475 480

Phe Ser Thr Tyr Ile Gly Asn Gln Phe Thr Arg Thr Glu Lys Leu Gln
485 490 495

Thr Gln Thr Gly Asn Asp Ser Met Lys Phe Asn Tyr Asn Gly Ile Ser
500 505 510

Gln Phe Ser Ser Val Arg Asn Arg Ser Ser Ser Ser Thr Leu Asp Lys
515 520 525

Leu Gly Phe Lys Ser Ser Gly Thr Asn Leu Asn Leu Arg Tyr Ala Asn
530 535 540

Asn Ser Ile Leu Ala Asp Ser Leu Phe Gly Ile Gln Tyr Asn Ile Ser
545 550 555 560

Asp Ser Pro Ile Asp Lys Tyr Gly Phe Lys Asp Ile Tyr Gln Lys Asp
565 570 575

Asn Leu Thr Leu Tyr Glu Asn Gln Tyr Ser Leu Pro Ile Ala Val Ala
580 585 590

Ser Gln Ser Val Tyr Asn Asp Val Lys Phe Asn Glu His Thr Leu Asp
595 600 605

Asn Gln Ala Ser Phe Leu Asn Gln Leu Ala Asn Val Asn Phe Asp Tyr
610 615 620

Phe Ser Pro Ile Pro Tyr Glu Lys Thr Glu Lys Ile Glu Asn Thr Asn
625 630 635 640

Asp Leu Ile Ser Val Thr Ser Ser Ser Asn Glu Asp Ala Ala Ile Gln
645 650 655

```
Tyr Gln Ile Glu Val Pro Glu Asn Ser Gln Val Tyr Leu Ser Phe Ile
            660                 665                 670

Asn Leu His Phe Ser Asn Asp Lys Gln Lys Lys Val Asp Ile Leu Val
        675                 680                 685

Asn Gly Glu Lys Lys Thr Phe Thr Thr Asp Asn Val Phe Ser Phe Phe
    690                 695                 700

Asn Leu Gly Tyr Thr Lys Glu Lys Lys Thr Phe Asn Ile Asn Val Ser
705                 710                 715                 720

Phe Pro Gly Asn Ser Gln Val Ser Phe Glu Ser Pro Thr Phe Tyr Arg
                725                 730                 735

Leu Asp Thr Lys Thr Phe Thr Glu Ala Ile Gln Lys Ile Lys Glu Gln
            740                 745                 750

Pro Val Thr Val Ser Thr Ser Lys Asn Lys Val Phe Ala Thr Tyr Asp
        755                 760                 765

Val Gln Gln Asp Thr Ser Ile Phe Phe Thr Ile Pro Tyr Asp Lys Gly
    770                 775                 780

Trp Ser Ala Tyr Gln Asp Gly Lys Lys Ile Glu Ile Lys Gln Ala Gln
785                 790                 795                 800

Thr Gly Phe Met Lys Val Asp Ile Pro Lys Gly Lys Gly Thr Ile Thr
                805                 810                 815

Leu Ser Phe Ile Pro Asn Gly Phe Ile Thr Gly Ala Ile Cys Ser Phe
            820                 825                 830

Thr Ser Leu Leu Leu Phe Gly Ile Tyr Asn His Arg Arg Lys Ser Ser
        835                 840                 845

Lys Ala
    850

<210>  422
<211>  250
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<212> PRT
<213> Streptococcus pneumoniae

<400> 422

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Met Lys Val Leu Ile Leu Glu Asp Val Ile Glu His Gln Val Arg Leu
1               5                   10                  15

Glu Arg Ile Leu Asp Glu Ile Ser Lys Glu Ser Asn Ile Pro Ile Ser
            20                  25                  30

Tyr Lys Thr Thr Gly Lys Val Arg Glu Phe Glu Glu Tyr Ile Glu Asn
        35                  40                  45

Asp Glu Val Asn Gln Leu Tyr Phe Leu Asp Ile Asp Ile His Gly Ile
    50                  55                  60

Glu Lys Lys Gly Phe Glu Val Ala Gln Leu Ile Arg His Tyr Asn Pro
65                  70                  75                  80

Tyr Ala Ile Ile Val Phe Ile Thr Ser Arg Ser Glu Phe Ala Thr Leu
                85                  90                  95

Thr Tyr Lys Tyr Gln Val Ser Ala Leu Asp Phe Val Asp Lys Asp Ile
            100                 105                 110

Asn Asp Glu Met Phe Lys Lys Arg Ile Glu Gln Asn Ile Phe Tyr Thr
        115                 120                 125

Lys Ser Met Leu Leu Glu Asn Glu Asp Val Val Asp Tyr Phe Asp Tyr
    130                 135                 140

Asn Tyr Lys Gly Asn Asp Leu Lys Ile Pro Tyr His Asp Ile Leu Tyr
145                 150                 155                 160

Ile Glu Thr Thr Gly Val Ser His Lys Leu Arg Ile Ile Gly Lys Asn
                165                 170                 175

Phe Ala Lys Glu Phe Tyr Gly Thr Met Thr Asp Ile Gln Glu Lys Asp
            180                 185                 190

Lys His Thr Gln Arg Phe Tyr Ser Pro His Lys Ser Phe Leu Val Asn
        195                 200                 205
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Ile Gly Asn Ile Arg Glu Ile Asp Arg Lys Asn Leu Glu Ile Val Phe
210 215 220

Tyr Glu Asp His Arg Cys Pro Ile Ser Arg Leu Lys Ile Arg Lys Leu
225 230 235 240

Lys Asp Ile Leu Glu Lys Lys Ser Gln Lys
245 250

<210> 423
<211> 441
<212> PRT
<213> Streptococcus pneumoniae

<400> 423

Met Asp Leu Leu Gly Phe Gly Thr Val Ile Val His Phe Leu Ile Ile
1 5 10 15

Ser His Ser Tyr Arg Leu Ile Cys Lys Gly Arg Ile Asn Arg Lys Glu
20 25 30

Leu Tyr Val Phe Gly Ala Tyr Thr Leu Leu Thr Glu Ile Val Leu Glu
35 40 45

Phe Ser Phe Tyr Leu Leu Tyr Leu Asp Lys Ile Gly Ile Glu Arg Phe
50 55 60

Leu Phe Pro Leu Gly Leu Tyr Ser Tyr Phe Arg Trp Met Lys Gln Tyr
65 70 75 80

Glu Arg Asp Arg Gly Leu Phe Leu Ser Leu Leu Leu Ser Leu Leu Tyr
85 90 95

Glu Ser Thr His Asn Phe Leu Ser Val Ile Phe Ser Ser Ile Thr Gly
100 105 110

Asp Asn Phe Val Leu Gln Tyr His Phe Pro Phe Phe Phe Val Val Thr
115 120 125

Val Leu Thr Tyr Phe Val Thr Leu Lys Ile Ile Tyr Tyr Phe His Leu
130 135 140

Glu Leu Ala Tyr Phe Asp Lys Asp Tyr Leu Tyr Pro Phe Leu Lys Lys
145   150   155   160

Val Phe Phe Ala Leu Leu Leu Leu His Ile Val Ser Phe Val Ser Asp
                165   170   175

Met Val Ser Thr Ile Lys His Leu Asn Ser Phe Gly Ser Ile Leu Ser
            180   185   190

Ser Ile Val Phe Ile Ser Leu Leu Leu Thr Phe Phe Ala Met Asn Ser
        195   200   205

His Lys Val Gln Met Glu Lys Glu Ile Ala Leu Lys Gln Lys Lys Phe
    210   215   220

Glu Gln Lys His Leu Gln Asn Tyr Thr Asp Glu Ile Val Gly Leu Tyr
225   230   235   240

Asn Glu Ile Arg Gly Phe Arg His Asp Tyr Ala Gly Met Leu Val Ser
                245   250   255

Met Gln Met Ala Ile Asp Ser Gly Asn Leu Gln Glu Ile Asp Arg Ile
            260   265   270

Tyr Asn Glu Val Leu Val Lys Ala Asn His Lys Leu Arg Ser Asp Lys
        275   280   285

Tyr Thr Tyr Phe Asp Leu Asn Asn Ile Glu Asp Ser Ala Leu Arg Ser
    290   295   300

Leu Val Ala Gln Ser Ile Val Tyr Ala Arg Asn Asn Gly Val Glu Phe
305   310   315   320

Thr Leu Glu Val Lys Asp Thr Ile Thr Lys Leu Pro Ile Glu Leu Leu
                325   330   335

Asp Leu Val Arg Ile Met Ser Val Leu Leu Asn Asn Ala Val Glu Gly
            340   345   350

Ser Ala Asp Ser Tyr Lys Lys Gln Met Glu Val Ala Val Ile Lys Met

355 360 365

Glu Thr Glu Thr Val Ile Val Ile Gln Asn Ser Cys Lys Met Thr Met
370 375 380

Thr Pro Ser Gly Asp Leu Phe Ala Leu Gly Phe Ser Thr Lys Gly Arg
385 390 395 400

Asn Arg Gly Val Gly Leu Asn Asn Val Lys Glu Leu Leu Asp Lys Tyr
405 410 415

Asn Asn Ile Ile Leu Glu Thr Glu Met Glu Gly Ser Thr Phe Arg Gln
420 425 430

Ile Ile Arg Phe Lys Arg Glu Phe Glu
435 440

<210> 424
<211> 122
<212> PRT
<213> Streptococcus pneumoniae

<400> 424

Met Ser Lys Asn Ile Val Gln Leu Asn Asn Ser Phe Ile Gln Asn Glu
1 5 10 15

Tyr Gln Arg Arg Arg Tyr Leu Met Lys Glu Arg Gln Lys Arg Asn Arg
20 25 30

Phe Met Gly Gly Val Leu Ile Leu Ile Met Leu Leu Phe Ile Leu Pro
35 40 45

Thr Phe Asn Leu Ala Gln Ser Tyr Gln Gln Leu Leu Gln Arg Arg Gln
50 55 60

Gln Leu Ala Asp Leu Gln Thr Gln Tyr Gln Thr Leu Ser Asp Glu Lys
65 70 75 80

Asp Lys Glu Thr Ala Phe Ala Thr Lys Leu Lys Asp Glu Asp Tyr Ala
85 90 95

Ala Lys Tyr Thr Arg Ala Lys Tyr Tyr Tyr Ser Lys Ser Arg Glu Lys

100 105 110

Val Tyr Thr Ile Pro Asp Leu Leu Gln Arg
115 120

<210> 425
<211> 420
<212> PRT
<213> Streptococcus pneumoniae

<400> 425

Met Glu Glu Val Glu Val Ala Glu Val Lys Asn Ala Arg Val Ser Leu
1 5 10 15

Thr Gly Glu Lys Thr Lys Pro Met Lys Leu Ala Glu Val Thr Ser Ile
20 25 30

Asn Val Asn Arg Thr Lys Thr Glu Met Glu Glu Phe Asn Arg Val Leu
35 40 45

Gly Gly Gly Val Val Pro Gly Ser Leu Val Leu Ile Gly Gly Asp Pro
50 55 60

Gly Ile Gly Lys Ser Thr Leu Leu Leu Gln Val Ser Thr Gln Leu Ser
65 70 75 80

Gln Val Gly Thr Val Leu Tyr Val Ser Gly Glu Glu Ser Ala Gln Gln
85 90 95

Ile Lys Leu Arg Ala Glu Arg Leu Gly Asp Ile Asp Ser Glu Phe Tyr
100 105 110

Leu Tyr Ala Glu Thr Asn Met Gln Ser Val Arg Ala Glu Val Glu Arg
115 120 125

Ile Gln Pro Asp Phe Leu Ile Ile Asp Ser Ile Gln Thr Ile Met Ser
130 135 140

Pro Glu Ile Ser Gly Val Gln Gly Ser Val Ser Gln Val Arg Glu Val
145 150 155 160

Thr Ala Glu Leu Met Gln Leu Ala Lys Thr Asn Asn Ile Ala Ile Phe

```
                165                 170                 175

Ile Val Gly His Val Thr Lys Glu Gly Thr Leu Ala Gly Pro Arg Met
            180                 185                 190

Leu Glu His Met Val Asp Thr Val Leu Tyr Phe Glu Gly Glu Arg His
        195                 200                 205

His Thr Phe Arg Ile Leu Arg Ala Val Lys Asn Arg Phe Gly Ser Thr
    210                 215                 220

Asn Glu Ile Gly Ile Phe Glu Met Gln Ser Gly Gly Leu Val Glu Val
225                 230                 235                 240

Leu Asn Pro Ser Gln Val Phe Leu Glu Glu Arg Leu Asp Gly Ala Thr
                245                 250                 255

Gly Ser Ser Ile Val Val Thr Met Glu Gly Thr Arg Pro Ile Leu Ala
            260                 265                 270

Glu Val Gln Ala Leu Val Thr Pro Thr Met Phe Gly Asn Ala Lys Arg
        275                 280                 285

Thr Thr Thr Gly Leu Asp Phe Asn Arg Ala Ser Leu Ile Met Ala Val
    290                 295                 300

Leu Glu Lys Arg Ala Gly Leu Leu Leu Gln Asn Gln Asp Ala Tyr Leu
305                 310                 315                 320

Lys Ser Ala Gly Gly Val Lys Leu Asp Glu Pro Ala Ile Asp Leu Ala
                325                 330                 335

Val Ala Val Ala Ile Ala Ser Ser Tyr Lys Asp Lys Pro Thr Asn Pro
            340                 345                 350

Gln Glu Cys Phe Val Gly Glu Leu Gly Leu Thr Gly Glu Ile Arg Arg
        355                 360                 365

Val Asn Arg Ile Glu Gln Arg Ile Asn Glu Ala Ala Lys Leu Gly Phe
    370                 375                 380
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Thr Lys Ile Tyr Val Pro Lys Asn Ser Leu Thr Gly Ile Thr Leu Pro
385 390 395 400

Lys Glu Ile Gln Val Ile Gly Val Thr Thr Ile Gln Glu Val Leu Lys
405 410 415

Lys Val Phe Ala
420

<210> 426
<211> 207
<212> PRT
<213> Streptococcus pneumoniae

<400> 426

Met Pro Lys Lys Val Leu Ile Leu Ser Leu Leu Gly Gly Met Phe Leu
1 5 10 15

Ser Gly Trp Leu Ser Ser Phe Ala Asn Thr Tyr Ile His Asp Leu Leu
20 25 30

Gly Val Leu Phe Pro Asp Ser Pro Phe Leu Asn Ala Phe Glu Ser Ala
35 40 45

Ile Ala Ala Pro Leu Val Glu Glu Pro Leu Lys Leu Leu Ser Leu Val
50 55 60

Phe Val Leu Ala Leu Ile Pro Val Arg Lys Leu Lys Ser Leu Phe Leu
65 70 75 80

Leu Gly Ile Ala Ser Gly Leu Gly Phe Gln Met Ile Lys Asp Ile Gly
85 90 95

Tyr Ile Arg Thr Asp Leu Pro Glu Gly Phe Asp Phe Thr Ile Ser Arg
100 105 110

Ile Leu Glu Arg Ile Ile Ser Gly Ile Ala Ser His Trp Thr Phe Ser
115 120 125

Gly Leu Ala Val Val Gly Val Tyr Leu Leu Tyr Arg Ala Tyr Lys Gly
130 135 140

Gln Lys Val Gly Lys Lys Gln Gly Leu Ile Phe Leu Gly Leu Ala Leu
145 150 155 160

Gly Thr His Phe Leu Phe Asn Ser Pro Phe Val Glu Leu Glu Thr Glu
165 170 175

Leu Pro Leu Ala Ile Pro Val Val Thr Ala Ile Ala Leu Tyr Gly Phe
180 185 190

Tyr His Ala Tyr Cys Phe Val Glu Lys His Asn Glu Leu Met Thr
195 200 205

<210> 427
<211> 717
<212> PRT
<213> Streptococcus pneumoniae

<400> 427

Met Lys Phe Gly Lys Arg His Tyr Arg Pro Gln Val Asp Gln Met Asp
1 5 10 15

Cys Gly Val Ala Ser Leu Ala Met Val Phe Gly Tyr Tyr Gly Ser Tyr
20 25 30

Tyr Phe Leu Ala His Leu Arg Glu Leu Ala Lys Thr Thr Met Asp Gly
35 40 45

Thr Thr Ala Leu Gly Leu Val Lys Val Ala Glu Glu Ile Gly Phe Glu
50 55 60

Thr Arg Ala Ile Lys Ala Asp Met Thr Leu Phe Asp Leu Pro Asp Leu
65 70 75 80

Thr Phe Pro Phe Val Ala His Val Leu Lys Glu Gly Lys Leu Leu His
85 90 95

Tyr Tyr Val Val Thr Gly Gln Asp Lys Asp Ser Ile His Ile Ala Asp
100 105 110

Pro Asp Pro Gly Val Lys Leu Thr Lys Leu Pro Arg Glu Arg Phe Glu
115 120 125

Glu Glu Trp Thr Gly Val Thr Leu Phe Met Ala Pro Ser Pro Asp Tyr
130 135 140

Lys Pro His Lys Glu Gln Lys Asn Gly Leu Leu Ser Phe Ile Pro Ile
145 150 155 160

Leu Val Lys Gln Arg Gly Leu Ile Ala Asn Ile Val Leu Ala Thr Leu
165 170 175

Leu Val Thr Val Ile Asn Ile Val Gly Ser Tyr Tyr Leu Gln Ser Ile
180 185 190

Ile Asp Thr Tyr Val Pro Asp Gln Met Arg Ser Thr Leu Gly Ile Ile
195 200 205

Ser Ile Gly Leu Val Ile Val Tyr Ile Phe Gln Gln Ile Leu Ser Tyr
210 215 220

Ala Gln Glu Tyr Leu Leu Leu Val Leu Gly Gln Arg Leu Ser Ile Asp
225 230 235 240

Val Ile Leu Ser Tyr Ile Lys His Val Phe His Leu Pro Met Ser Phe
245 250 255

Phe Ala Thr Arg Arg Thr Gly Glu Ile Val Ser Arg Phe Thr Asp Ala
260 265 270

Asn Ser Ile Ile Asp Ala Leu Ala Ser Thr Ile Leu Ser Ile Phe Leu
275 280 285

Asp Val Ser Thr Val Val Ile Ile Ser Leu Val Leu Phe Ser Gln Asn
290 295 300

Thr Asn Leu Phe Phe Met Thr Leu Leu Ala Leu Pro Ile Tyr Thr Val
305 310 315 320

Ile Ile Phe Ala Phe Met Lys Pro Phe Glu Lys Met Asn Arg Asp Thr
325 330 335

Met Glu Ala Asn Ala Val Leu Ser Ser Ser Ile Ile Glu Asp Ile Asn
340 345 350

```
Gly Ile Glu Thr Ile Lys Ser Leu Thr Ser Glu Ser Gln Arg Tyr Gln
        355                 360                 365

Lys Ile Asp Lys Glu Phe Val Asp Tyr Leu Lys Lys Ser Phe Thr Tyr
    370                 375                 380

Ser Arg Ala Glu Ser Gln Gln Lys Ala Leu Lys Lys Val Ala His Leu
385                 390                 395                 400

Leu Leu Asn Val Gly Ile Leu Trp Met Gly Ala Val Leu Val Met Asp
                405                 410                 415

Gly Lys Met Ser Leu Gly Gln Leu Ile Thr Tyr Asn Thr Leu Leu Val
            420                 425                 430

Tyr Phe Thr Asn Pro Leu Glu Asn Ile Ile Asn Leu Gln Thr Lys Leu
        435                 440                 445

Gln Thr Ala Gln Val Ala Asn Asn Arg Leu Asn Glu Val Tyr Leu Val
    450                 455                 460

Ala Ser Glu Phe Glu Glu Lys Lys Thr Val Glu Asp Leu Ser Leu Met
465                 470                 475                 480

Lys Gly Asp Met Thr Phe Lys Gln Val His Tyr Lys Tyr Gly Tyr Gly
                485                 490                 495

Arg Asp Val Leu Ser Asp Ile Asn Leu Thr Val Pro Gln Gly Ser Lys
            500                 505                 510

Val Ala Phe Val Gly Ile Ser Gly Ser Gly Lys Thr Thr Leu Ala Lys
        515                 520                 525

Met Met Val Asn Phe Tyr Asp Pro Ser Gln Gly Glu Ile Ser Leu Gly
    530                 535                 540

Ser Val Asn Leu Asn Gln Ile Asp Lys Lys Ala Leu Arg Gln Tyr Ile
545                 550                 555                 560

Asn Tyr Leu Ser Gln Gln Pro Tyr Val Phe Asn Gly Thr Ile Leu Glu
                565                 570                 575
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Asn Leu Leu Leu Gly Ala Lys Glu Gly Thr Thr Gln Glu Asp Ile Leu
580 585 590

Arg Ala Val Glu Leu Ala Glu Ile Arg Glu Asp Ile Glu Arg Met Pro
595 600 605

Leu Asn Tyr Gln Thr Glu Leu Thr Ser Asp Gly Ala Gly Ile Ser Gly
610 615 620

Gly Gln Arg Gln Arg Ile Ala Leu Ala Arg Ala Leu Leu Thr Asp Ala
625 630 635 640

Pro Val Leu Ile Leu Asp Glu Ala Thr Ser Ser Leu Asp Ile Leu Thr
645 650 655

Glu Lys Arg Ile Val Asp Asn Leu Ile Ala Leu Asp Lys Thr Leu Ile
660 665 670

Phe Ile Ala His Arg Leu Thr Ile Ala Glu Arg Thr Glu Lys Val Val
675 680 685

Val Leu Asp Gln Gly Lys Ile Val Glu Glu Gly Lys His Ala Asp Leu
690 695 700

Leu Ala Gln Gly Gly Phe Tyr Ala His Leu Val Asn Ser
705 710 715

<210> 428
<211> 319
<212> PRT
<213> Streptococcus pneumoniae

<400> 428

Met Asp Ile Lys Ile Lys Arg Glu Glu Ile Met Lys Lys Phe Ser Lys
1 5 10 15

Thr Leu Arg Asp Asn Trp Ile Phe Leu Leu Met Val Leu Pro Gly Ala
20 25 30

Leu Trp Leu Ile Leu Phe Phe Tyr Ile Pro Val Phe Gly Asn Val Val
35 40 45

```
Ala Phe Lys Asp Tyr His Met Thr Ser Asn Gly Phe Ile Asp Ser Ile
    50                  55                  60

Ile Asn Ser Lys Trp Val Gly Leu Asp Asn Phe Arg Phe Leu Phe Ser
65                  70                  75                  80

Ser Arg Asp Ala Phe Ile Ile Thr Arg Asn Thr Val Leu Tyr Asn Leu
                85                  90                  95

Gly Phe Ile Phe Leu Gly Leu Val Val Ser Val Gly Ile Ala Ile Ile
            100                 105                 110

Leu Ser Glu Leu Arg Ser Lys Arg Met Val Lys Ile Phe Gln Thr Ser
        115                 120                 125

Met Leu Phe Pro Tyr Phe Leu Ser Trp Val Ile Ile Ser Phe Phe Thr
    130                 135                 140

Asp Ala Phe Leu Asn Ile Asp Lys Gly Val Phe Asn His Leu Leu Glu
145                 150                 155                 160

Ser Leu Gly Leu Lys Glu Val Asn Phe Tyr Ala Asp Leu Gly Ile Trp
                165                 170                 175

Pro Tyr Leu Leu Leu Phe Leu Gly Ile Trp Lys Gly Phe Gly Tyr Ser
            180                 185                 190

Ser Val Met Tyr Tyr Ala Thr Ile Met Gly Ile Asp Pro Thr Tyr Tyr
        195                 200                 205

Glu Ala Ala Thr Val Asp Gly Ala Ser Lys Trp Gln Arg Ile Arg Asn
    210                 215                 220

Val Thr Ile Pro Gln Leu Thr Pro Leu Val Thr Val Leu Thr Ile Leu
225                 230                 235                 240

Ala Val Gly Asn Ile Phe Arg Ala Asp Phe Gly Leu Phe Tyr Gln Ile
                245                 250                 255

Pro His Asn Ala Gly Gln Leu Tyr Asn Val Thr Asn Val Leu Asp Val
```

260 265 270

Tyr Val Phe Asn Gly Leu Thr Gln Thr Ala Asp Ile Gly Met Ala Ala
275 280 285

Ala Ala Gly Leu Tyr Gln Ser Val Val Gly Leu Ile Leu Val Ile Leu
290 295 300

Ser Asn Leu Leu Ala Arg Arg Val Asp Pro Asn Ser Ala Leu Phe
305 310 315

<210> 429
<211> 388
<212> PRT
<213> Streptococcus pneumoniae

<400> 429

Met Lys Lys Gln Ser Leu Phe Phe Val Pro Gly Ile Ile Leu Ile Gly
1 5 10 15

Val Ser Leu Arg Thr Pro Phe Thr Val Leu Pro Ile Ile Leu Gly Asn
20 25 30

Ile Ser Gln Gly Leu Glu Val Glu Val Ser Ser Leu Gly Val Leu Thr
35 40 45

Ser Leu Pro Leu Leu Met Phe Thr Leu Phe Ser Pro Phe Ser Thr Gln
50 55 60

Leu Ala Gln Lys Ile Gly Leu Glu His Leu Phe Thr Tyr Ser Leu Phe
65 70 75 80

Phe Leu Thr Ile Gly Ser Leu Ile Arg Leu Ile Asn Leu Pro Leu Leu
85 90 95

Tyr Leu Gly Thr Leu Met Val Gly Ala Ser Val Ala Val Ile Asn Val
100 105 110

Leu Leu Pro Ser Leu Ile Gln Ala Asn Gln Pro Lys Lys Ile Gly Phe
115 120 125

Leu Thr Thr Leu Tyr Val Thr Ser Met Gly Ile Ala Thr Ala Leu Ala

130 135 140

Ser Tyr Leu Ala Val Pro Ile Thr Gln Ala Ser Ser Trp Lys Gly Leu
145 150 155 160

Ile Leu Leu Leu Thr Leu Leu Cys Leu Ala Thr Phe Leu Val Trp Leu
165 170 175

Pro Asn His Arg Tyr Asn His Arg Leu Ala Pro Gln Thr Lys Gln Lys
180 185 190

Ser Gln Ile Lys Val Met Arg Asn Lys Gln Val Trp Ala Ile Ile Ile
195 200 205

Phe Ser Gly Phe Gln Ser Leu Ile Phe Tyr Thr Val Met Thr Trp Leu
210 215 220

Pro Thr Met Ser Ile His Ala Gly Leu Ser Ser His Glu Ala Gly Leu
225 230 235 240

Leu Thr Ser Ile Leu Ser Leu Ile Ser Ile Pro Phe Ser Met Thr Ile
245 250 255

Pro Ser Leu Thr Thr Ser Leu Ser Thr Arg Asn Arg Gln Leu Met Leu
260 265 270

Thr Leu Val Ser Leu Ala Gly Val Val Gly Ile Ser Met Leu Phe Phe
275 280 285

Pro Ile Asn Asn Phe Ile Tyr Trp Leu Ala Ile His Leu Leu Ile Gly
290 295 300

Thr Ala Thr Ser Ala Leu Phe Pro Tyr Leu Met Val Asn Phe Ser Leu
305 310 315 320

Lys Thr Ser Ala Pro Glu Lys Thr Ala Gln Leu Ser Gly Leu Ser Gln
325 330 335

Thr Gly Gly Tyr Ile Leu Ala Ala Phe Gly Pro Thr Leu Phe Gly Tyr
340 345 350

Ser Phe Asp Leu Phe His Ser Trp Val Pro Ser Val Ala Ala Leu Leu
355 360 365

Leu Ile Asp Ile Leu Met Thr Val Ala Leu Phe Thr Val Asp Arg Ala
370 375 380

Asp Lys Ile Leu
385

<210> 430
<211> 150
<212> PRT
<213> Streptococcus pneumoniae

<400> 430

Met Asp Phe Leu Phe Ala Ala Gly Ala Phe Gly Leu Val Ile Ala Asn
1 5 10 15

Asn Ala Ser Ile Ser Gly Ala Glu Gly Gly Cys Gln Ala Glu Val Gly
20 25 30

Ser Ala Ser Ala Met Ser Ala Ala Ala Leu Thr Leu Ala Ala Gly Gly
35 40 45

Thr Pro Tyr Gln Ala Ser Gln Ala Ile Ala Phe Val Ile Lys Asn Met
50 55 60

Leu Gly Leu Ile Cys Asp Pro Val Ala Gly Leu Val Glu Val Pro Cys
65 70 75 80

Val Lys Arg Asn Ala Met Gly Ala Ser Phe Ala Phe Ile Ala Ala Asp
85 90 95

Met Ala Leu Ala Gly Ile Glu Ser Lys Ile Pro Val Asp Glu Val Ile
100 105 110

Asp Ala Met Tyr Gln Val Gly Ala Ser Met Pro Thr Ala Phe Arg Glu
115 120 125

Thr Ala Glu Gly Gly Leu Ala Thr Thr Pro Thr Gly Arg Arg Leu Gln
130 135 140

Lys Glu Ile Phe Gly Glu
145 150

<210> 431
<211> 663
<212> DNA
<213> Streptococcus pneumoniae

<400> 431
ggaagtagtt ttatgaatat agcagtaatt ggtttggggc atgttgggct ggcctacgcg 60

ttactatttg catctaaata taaagttgtt gcatatgata tagattctgt aaaaataaat 120

aatttaaaaa agggcattct tccatctaaa aatgaagagc ttatgaagtt tttttgcgag 180

aataacttaa atattacttt ttttgataca ttttctgaaa ttaaaaataa tattgattat 240

tatattattg cgcttccgac agattatgat gagaaaattg gtagttttaa tacatatgaa 300

atcgaacaaa cggtatcgaa gattctgagg gtaaaaccta atggaaagat tattttaaag 360

tcaacagttc cgatcggctt ttcaaacaaa ttaaaaaggc tgtttgatac aaaaaatatc 420

atttttgtcc ctgaattttt gagagaaggt tgttctatat atgataattt atatccaagt 480

cgcatagttg ttggagatga gacagttgaa ggaagaaaaa ttgcagagtt gttcctttcg 540

attagtactc atagtactgc caatattaaa aatgttatgt tagtttctcc tactgaagca 600

gaagcaatta agcttttttc taacacattc ttagctctcc gtgttgcttt tttaatgaac 660

tag 663

<210> 432
<211> 708
<212> DNA
<213> Streptococcus pneumoniae

<400> 432
aaaatggttc taagaggagt tcctatgtct caaattgatc tacaaaaatt aactaagaaa 60

aaccaagagt ttgtccacat tgctacccaa caattcatca aagatgggaa aacagacgct 120

gaaatccaga ctatttttga ggaagtcatt ccccaaatcc ttgaggagca atctaaaggt 180

acaactgccc gttccctata cggcgcacca actcattggg ctcatagctt cactgtcaaa 240

gagcagtacg aaaaagagca tccaaaagaa aatgatgacc caaaactgat gattatggac 300

tcagctcttt tcatcactag cctctttgcc cttgtcagcg ccctcacaac cttctttgcg 360

gcagaccaag ctttcggcta tggattgatt actcttctat tagttggact ggttggtgga 420

tttgccttct acttgatgta ctactttgtt taccaatact atggaccaga tatggatcgc 480

agtcaacgtc cacctttctg gaaatctgta ctagttatcc tagcttctat gttcctttgg 540

ttgcttgtct tctttgcaac aagcttccta ccagctagcc ttaacccagt actggatcca 600

ttgccactag ctattattgg agcagccctc ctagcccttc gcttctatct caagaaacgc 660

ttgaatatcc gtagtgcaag tgcaggacca acacgctatc aagaataa 708

<210> 433
<211> 960
<212> DNA
<213> Streptococcus pneumoniae

<400> 433
gaaaggataa gggatatgaa acaagttttt ctctctacaa caactgaatt taaagagatc 60

gatacgcttg aaccgggtac ttggatcaat ctcgtcaatc cgactcaaaa tgaatcactc 120

gaaatcgcca acaccttcga tattgatatt gctgaccttc gagcaccgct cgatgcggaa 180

gaaatgtctc gtattaccat tgaagacgag tataccctga ttatcgtaga cgtgccggtc 240

acggaggaaa gaaataaccg cacctactac gtaaccatcc cgcttggtat tatcatcact 300

gaggaaacca ttatcactac gtgtttggaa ccactacctg tccttgatgt ctttatcaac 360

cgtcgattgc gtaatttcta taccttcatg cgttcacgtt ttatctttca aattctttat 420

cgcaatgcag agctttacct aacagccctt cgttcaatcg accgcaagag tgaacaaatc 480

gaaagtcaac tgcatcaatc aactcgtaat gaagaattga ttgagctcat ggaattggaa 540

aaaactatcg tctatttcaa ggcctccctc aaaacaaatg agcgcgtgat taagaaattg 600

accagttcaa ccagcaatat caagaaatac cttgaggacg aagacctgct tgaagacacc 660

ctgattgaaa cccaacaggc catcgagatg gcagatattt atggaaacgt cttgcattct 720

atgacagaga cctttgcctc tatcatttct aacaaccaga acaacatcat gaaaaccttg 780

gcccttgtga ccatcgtcat gtccatccca accatggtct tttctgccta cgggatgaac 840

tttaaggata atgaaatccc cctaaacgga gagccaaatg ccttctggtt aatcgtcttt 900

atcgcctttg ctatgagtgt ctcgctcact ctctatctca tccataaaaa atggttctaa 960

<210> 434
<211> 330
<212> DNA
<213> Streptococcus pneumoniae

<400> 434
atagacgaaa aggagaaaaa gatggcaaac aaaaaaatcc gtatccgttt gaaagcttac 60

gaacaccgta cgcttgacac agcggctgca aaaatcgtag aatcagctac tcgtacaggt 120

gcacaagttg cgggtccaat cccacttcca actgaacgta gcctctacac aatcattcgt 180

gcgactcaca aatacaaaga ctctcgcgaa caatttgaaa tgcgtacaca caaacgtttg 240

atcgatatcg ttaacccaac tcaaaaaaca gttgatgcct tgatgaaatt ggatcttcca 300

agtggtgtaa acgtagaaat caaactttaa 330

<210> 435
<211> 645
<212> DNA
<213> Streptococcus pneumoniae

<400> 435
aaaaggaact attttctcat gacaaaagga atcttaggga aaaaagtggg aatgactcaa 60

atcttcactg aagctggcga attgatccct gtaacagtta ttgaagcaac tccaaacgtt 120

gttcttcaag ttaaaactgt tgaaacagac ggatacaacg ctatccaagt tggtttcgat 180

gacaaacgcg aagtattgag caacaaacct gctaaaggac atgtagcgaa agctaacacg 240

gctcctaagc gcttcattcg tgaattcaaa aacgttgaag gcttggaagt tggtgctgaa 300

attacagttg aaacattcgc agctggagac gttgttgacg taacgggtac ttctaaaggt 360

aaaggtttcc aaggtgttat caaacgccac ggacaatcac gtggaccaat ggctcacggt 420

tctcgttacc accgtcgtcc aggttctatg ggccctgttg cacctaaccg cgtattcaaa 480

ggtaaaaacc ttgcaggacg tatgggtggc gaccgcgtaa caattcaaaa ccttgaagtt 540

gtacaagttg ttccagaaaa gaacgttatc cttatcaaag gtaacgtacc aggtgctaag 600

aaatctctta tcactatcaa atcagcagtt aaagctggta aataa 645

<210> 436
<211> 645
<212> DNA
<213> Streptococcus pneumoniae

<400> 436
agaaagggga aatcagtcac aatggcaaac gtaacattat ttgaccaaac tggtaaagaa 60

gctggccaag ttgttcttag cgatgcagta tttggtatcg aaccaaatga atcagttgtg 120

tttgatgtaa tcatcagcca acgcgcaagc cttcgtcaag gaacacacgc tgttaaaaac 180

cgctctgcag tatcaggtgg tggacgcaaa ccatggcgtc aaaaaggaac tggacgtgct 240

cgtcaaggtt ctatccgctc accacaatgg cgtggtggtg gtgttgtctt cggaccaact 300

ccacgttcat acggctacaa acttccacaa aaagttcgtc gcctagctct taaatcagtt 360

tactctgaaa aagttgctga aaacaaattc gtagctgtag acgctctttc atttacagct 420

ccaaaaactg ctgaatttgc aaaagttctt gcagcattga gcatcgattc taaagttctt 480

gttatccttg aagaaggaaa tgaattcgca gctctttcag ctcgtaacct tccaaacgtg 540

aaagttgcaa ctgctacaac tgcaagtgtt cttgacatcg caaatagcga caaacttctt 600

gtcacacaag cagctatctc taaaatcgag gaggttcttg cataa 645

<210> 437
<211> 318
<212> DNA
<213> Streptococcus pneumoniae

<400> 437
aatcgaggag gttcttgcat aatgaatttg tatgatgtta tcaaaaaacc tgtcatcact 60

gaaagctcaa tggctcaact tgaagcagga aaatatgtat ttgaagttga cactcgtgca 120

cacaaacttt tgatcaagca agctgttgaa gctgctttcg aaggtgttaa agttgccaat 180

gttaacacaa tcaacgtaaa accaaaagct aaacgtgttg gacgttacac tggttttact 240

aacaaaacta aaaaagctat catcacactt acagctgatt ctaaagcaat cgagttgttt 300

gctgctgaag ctgaataa 318

<210> 438
<211> 846
<212> DNA
<213> Streptococcus pneumoniae

<400> 438
ggaggaaata tcgtgggaat tcgtgtttat aaaccaacaa caaacggtcg ccgtaatatg 60

acttctttgg atttcgctga aatcacaaca agcactcctg aaaaatcatt gcttgttgca 120

ttgaagagca aggctggtcg taacaacaac ggtcgtatca cagttcgtca ccaaggtggt 180

ggacacaaac gtttctaccg tttggttgac ttcaaacgta ataaagacaa cgttgaagca 240

gttgttaaaa caatcgagta cgatccaaac cgttctgcaa acatcgctct tgtacactac 300

actgacggtg tgaaagcata catcatcgct ccaaaaggtc ttgaagtagg tcaacgtatc 360

gtttcaggtc cagaagcaga tatcaaagtc ggaaacgctc ttccacttgc taacatccca 420

gttggtactt tgattcacaa catcgagttg aaaccaggtc gtggtggtga attggtacgt 480

gctgctggtg catctgctca agtattgggt tctgaaggta aatatgttct tgttcgtctt 540

caatcaggtg aagttcgtat gattcttgga acttgccgtg ctacagttgg tgttgtcgga 600

aacgaacaac atggacttgt aaaccttggt aaagcaggac gtagccgttg gaaaggtatc 660

cgcccaacag ttcgtggttc tgtaatgaac cctaacgatc acccacacgg tggtggtgaa 720

ggtaaagcac cagttggtcg taaagcacca tctactccat ggggcaaacc tgctcttggt 780

cttaaaactc gtaacaagaa agcgaaatct gacaaactta tcgttcgtcg tcgcaacgag 840

aaataa 846

<210> 439
<211> 366
<212> DNA
<213> Streptococcus pneumoniae

<400> 439
gcaactagta aatccgccag ctcggtagcg ctccatagga gtgcaagccg ctgtggtaca 60

acatttaaag gagaaaatat aaaaatggga cgcagtctta aaaaaggacc tttcgtcgat 120

gagcatttga tgaaaaaagt tgaagctcaa gctaacgacg aaaagaaaaa agttattaaa 180

acttggtcac gtcgttcaac gatcttccca agtttcattg gttacactat tgcagtttat 240

gacggacgta aacacgtacc tgtttacatc caagaagaca tggtaggcca caaacttggt 300

gaatttgcac caactcgtac ttacaaaggt cacgctgcag acgacaagaa aacacgtaga 360

aaataa 366

<210> 440
<211> 345
<212> DNA
<213> Streptococcus pneumoniae

<400> 440
atggcagaaa ttacttcagc taaagcaatg gctcgtacag tacgtgtttc acctcgtaaa 60

tcacgtcttg ttcttgataa catccgtggt aaaagcgtag ccgatgcaat cgcaatcttg 120

acattcactc caaacaaagc tgctgaaatc atcttgaaag ttttgaactc agctgtagct 180

aacgctgaaa acaactttgg tttggataaa gctaacttgg tagtatctga agcattcgca 240

aacgaaggac caactatgaa acgtttccgt ccacgtgcga aaggttcagc ttcaccaatc 300

aacaaacgta cagctcacat cactgtagct gttgcagaaa aataa 345

<210> 441
<211> 666
<212> DNA
<213> Streptococcus pneumoniae

<400> 441
ggaggtaaaa tcgtgggtca aaaagtacat ccaattggta tgcgtgtcgg catcatccgt 60

gattgggatg ccaaatggta tgctgaaaaa gaatacgcgg attaccttca tgaagatctt 120

gcaatccgta aattcgttca aaaagaactt gctgacgcag cagtttcaac tattgaaatc 180

gaacgcgcag taaacaaagt taacgtttca cttcacactg ctaaaccagg tatggttatc 240

ggtaaaggtg gtgctaacgt tgatgcactc cgtgcaaaac ttaacaaatt gactggaaaa 300

caagtacaca tcaacatcat cgaaatcaaa caacctgatt tggatgctca ccttgtaggt 360

gaaggaattg ctcgtcaatt ggagcaacgt gttgctttcc gtcgtgcaca aaaacaagca 420

atccaacgtg caatgcgtgc tggagctaaa ggaatcaaaa ctcaagtatc aggtcgtttg 480

aacggtgcag atatcgcccg tgctgaagga tactctgaag gaactgttcc gcttcacaca 540

cttcgtgcag atatcgatta cgcttgggaa gaagcagata ctacatacgg taaacttggt 600

gttaaagtat ggatctaccg tggtgaagtt cttccagctc gtaaaaacac taaaggaggt 660

aaataa 666

<210> 442
<211> 384
<212> DNA
<213> Streptococcus pneumoniae

<400> 442
aaggagaaaa ctgaaatgat tcaaacagaa actcgtttga aagtcgcaga caacagcggt 60

gctcgcgaaa tcttgactat caaagttctt ggtggttcag gacgtaaatt tgcaaacatc 120

ggtgatgtta tcgtggcatc tgtaaaacaa gctactcctg gtggtgcggt taaaaaaggt 180

gacgttgtta aagcagttat cgttcgtact aaatcaggtg ctcgtcgtgc tgatggttca 240

tacatcaaat ttgacgaaaa cgcagcagtt atcatccgtg aagacaaaac tcctcgcgga 300

acacgtatct ttggcccagt tgcacgtgaa ttgcgtgaag gtggcttcat gaagatcgtg 360

tcacttgctc cagaagtact ttaa 384

<210> 443
<211> 327
<212> DNA
<213> Streptococcus pneumoniae

<400> 443
gaaaaatcaa ggagaaacct aatgtttgta aaaaaaggcg acaaagttcg cgtaatcgct 60

ggtaaagata agggaacaga agctgttgtc cttactgccc ttccaaaagt aaacaaagtt 120

atcgttgaag gtgttaacat tgttaagaaa caccaacgtc caactaacga gcttcctcaa 180

ggtggtatca tcgagaaaga agcagctatc cacgtatcaa acgttcaagt tttggacaaa 240

aatggtgtag ctggtcgtgt tggatacaaa tttgtagacg gtaaaaaagt tcgctacaac 300

aaaaaatcag gcgaagtgct tgattaa 327

<210> 444
<211> 570
<212> DNA
<213> Streptococcus pneumoniae

<400> 444
ttaatcacga aggaaaggag aagtataatg gcaaatcgtt taaaagaaaa atatcttaat 60

gaagtagttc ctgctttgac agaacaattc aactactcat cagtgatggc tgtgcctaaa 120

gtagataaga ttgttttgaa catgggtgtt ggtgaagctg tatcaaacgc taaaagcctt 180

gaaaaagctg ctgaagaatt ggcacttatc tcaggtcaaa aaccacttat cactaaagct 240

aaaaaatcaa tcgccggctt ccgtcttcgt gaaggtgttg cgatcggtgc aaaagttacc 300

cttcgtggtg aacgtatgta cgaattcttg gataaattgg tatcagtttc acttccacgt 360

gtacgtgact tccacggtgt cccaacaaaa tcatttgatg gacgcgggaa ctacacactt 420

ggtgtgaaag aacaattaat cttcccagaa atcaacttcg atgacgttga caaaactcgt 480

ggtcttgaca tcgttatcgt aacaactgct aacactgacg aagagtcacg tgcattgctt 540

acaggccttg gaatgccttt tgcaaaataa 570

<210> 445
<211> 414
<212> DNA
<213> Streptococcus pneumoniae

<400> 445
gaggagaaaa acaaaatggt tatgactgac ccaatcgcag acttcctaac tcgtattcgt 60

aatgctaacc aagctaaaca cgaagtactt gaagtacctg catcaaacat caaaaaaggg 120

attgctgaaa tccttaaacg cgaaggtttt gtaaaaaacg ttgaaatcat tgaagatgac 180

aaacaaggcg tcatccgtgt atttcttaaa tacggaccaa atggtgagaa agttatcact 240

aacttgaaac gtgtttctaa accaggactt cgtgtctaca aaaaacgtga agaccttcca 300

aaagttctta acggacttgg aattgccatc ctttcaactt ctgaaggttt gcttactgat 360

aaagaagcac gccaaaagaa tgttggtggt gaggttatcg cttacgtttg gtaa 414

<210> 446
<211> 552
<212> DNA
<213> Streptococcus pneumoniae

<400> 446
caggagaaaa taaacatgtc acgtattggt aataaagtta tcgtgttgcc tgctggtgtt 60

gaactcgcta acaatgacaa cgttgtaact gtaaaaggat ctaaaggaga acttactcgt 120

gagttctcaa aagatattga aatccgtgtg gaaggtactg aaataactct tcaccgtcca 180

aacgattcaa aagaaatgaa aactatccac ggaactactc gtgccctttt gaacaacatg 240

gttgttggtg tatcagaagg attcaagaaa gaacttgaaa tgcgtggggt tggttaccgt 300

gcacagcttc aaggatctaa acttgttttg gctgttggta aatctcatcc agacgaagtt 360

gaagctccag aaggaattac ttttgaactt ccaaacccaa caacaatcgt tgttagcgga 420

atttcaaaag aagtagttgg tcaaacagct gcttacgtac gtagccttcg ttcaccagaa 480

ccatataaag gtaaaggtat ccgttacgtt ggtgaattcg ttcgccgtaa agaaggtaaa 540

acaggtaaat aa 552

<210> 447
<211> 426
<212> DNA
<213> Streptococcus pneumoniae

<400> 447
tcatcaacca ccaacctatt ttccaacttt gtgcatagca cacgatttaa aactaaagag 60

gtgaaaactg tgatttcaaa accagataaa aacaaactcc gccaaaaacg ccaccgtcgc 120

gttcgcggaa aactctctgg aactgctgat cgcccacgtt tgaacgtatt ccgttctaat 180

acaggcatct acgctcaagt gattgatgac gtagcgggtg taacgctcgc aagtgcttca 240

actcttgata aagaagtttc aaaaggaact aaaactgaac aagccgttgc tgtcggtaaa 300

ctcgttgcag aacgtgcaaa cgctaaaggt atttcagaag tggtgttcga ccgcggtgga 360

tatctatatc acggacgtgt gaaagctttg gctgatgcag ctcgtgaaaa cggattgaaa 420

ttctaa 426

<210> 448
<211> 498
<212> DNA
<213> Streptococcus pneumoniae

<400> 448
aaaatggcat ttaaagacaa tgcagttgaa ttagaagaac gcgtagttgc tgtcaaccgt 60

gttacaaaag ttgttaaagg tggacgtcgt cttcgtttcg cagctcttgt tgttgttggt 120

gaccacaatg gtcgcgtagg atttggtact ggtaaagctc aagaagttcc agaagcaatc 180

cgtaaagcag tagatgatgc taagaaaaac ttgatcgaag ttcctatggt tggaacaaca 240

atcccacacg aagttctttc agaattcggt ggagctaaag tattgttgaa acctgctgta 300

gaaggttctg gagttgccgc tggtggtgca gttcgtgccg ttgtggaatt ggcaggtgtg 360

gcagatatta catctaaatc acttggttct aacactccaa tcaacattgt tcgtgcaact 420

gttgaaggtt tgaaacaatt gaaacgcgct gaagaaattg ctgcccttcg tggtatttca 480

gtttctgatt tggcataa 498

<210> 449
<211> 468
<212> DNA
<213> Streptococcus pneumoniae

<400> 449
cattttacaa aagaggagaa aataaaaatg aaacttcatg aattgaaacc tgcagaaggt 60

tctcgtaaag tacgtaaccg cgttggtcgt ggtacttcat caggtaacgg taaaacatct 120

ggtcgtggtc aaaaaggtca aaaagctcgt agcggtggcg gagttcgcct tggttttgaa 180

ggtggacaaa ctccattgtt ccgtcgtctt ccaaaacgtg gattcactaa catcaacgct 240

aaagaatacg caattgtgaa ccttgaccaa ttgaacgtct ttgaagatgg tgctgaagta 300

actccagttg ttcttatcga agcaggaatt gttaaagctg aaaagtcagg tattaaaatt 360

cttggtaacg gtgagttgac taagaaattg actgtgaaag cagctaaatt ctctaaatca 420

gctgaagaag ctatcactgc taaaggtggt tcagtagaag tcatctaa 468

<210> 450
<211> 1314
<212> DNA
<213> Streptococcus pneumoniae

<400> 450
cctatgtttt ttaaattatt aagagaagct cttaaagtca agcaggttcg atcaaaaatt 60

ttatttacaa tttttatcgt tttggtcttt cgtatcggaa ctagcattac agttcctggt 120

gtgaatgcca atagcttgaa tgctttaagt ggattatcct tcttaaacat gttgagcttg 180

gtgtcgggga atgccctaaa aaacttttcg atttttgccc taggagttag tccctatatc 240

accgcttcta ttgttgtcca actcttgcaa atggatattt tacccaagtt tgtagagtgg 300

ggtaaacaag gggaagtagg tcgaagaaaa ttgaatcaag ctactcgtta tattgctcta 360

gttctcgctt ttgtgcaatc tatcgggatt acagctggtt ttaatacctt ggctggagct 420

caattgatta aaactgcttt aactccacaa gtttttctga cgattggtat catcttaaca 480

gctggtagta tgattgtcac ttggttgggt gagcaaatta cagataaggg atacggaaac 540

ggtgtttcca tgattatctt tgccgggatt gtttcctcaa ttccagagat gattcagggc 600

atctatgtgg actactttgt gaacgtccca agtagccgta tcacttcatc tatcattttc 660

gtaatcattt tgattattac tgtattgttg attatttact ttacaactta tgttcaacaa 720

gcagaataca aaattccaat ccaatatact aaggttgcac aaggtgctcc atctagctct 780

taccttccgt taaaagtaaa ccctgctgga gttatccctg ttatctttgc cagttcgatt 840

actgcagcgc ctgcggctat tcttcagttt ttgagtgcca caggtcatga ttgggcttgg 900

gtaagggtag cacaagagat gttggcaact acttctccaa ctggtattgc catgtatgct 960

ttgttgatta ttctctttac attcttctat acgtttgtac agattaatcc tgaaaaagca 1020

gcagagagcc tacaaaagag tggtgcctat atccatggag ttcgtcctgg taaaggtaca 1080

gaagaatata tgtctaaact tcttcgtcgt cttgcaactg ttggttccct cttccttggt 1140

gtgatttcca ttttaccgat tgcagctaaa gatgtatttg gtctttctga tgttgttgcc 1200

tttggtggaa caagtctctt gatcattatc tctacaggta tcgaaggaat caagcaattg 1260

gaaggttacc tattgaaacg taagtatgtt ggtttcatgg acagaacaga ataa 1314

<210> 451
<211> 651
<212> DNA
<213> Streptococcus pneumoniae

<400> 451
ggagatcaaa tcatgaatct tttgattatg ggcttacctg gtgcaggtaa gggaactcaa 60

gcagcaaaaa tcgtagaaca attccatgtt gcacatatct caacaggtga tatgttccgc 120

gctgcaatgg caaatcaaac tgaaatgggt gttcttgcta agtcatatat tgacaagggt 180

gaattggttc ctgacgaagt tacaaatgga atcgtaaaag aacgcctttc acaagatgat 240

attaaagaaa caggattctt attggatggt tacccacgta caattgaaca agctcatgcc 300

ttggacaaaa cattggctga acttggcatt gaactagaag gtgttatcaa tattgaagtg 360

aaccctgaca gccttttgga acgtttgagt gggcgtatca tccaccgcgt aactggagaa 420

actttccaca aggtctttaa cccaccagtt gactataaag aagaagatta ctaccaacgt 480

gaagatgata agcctgagac agtaaaacgt cgtttggatg ttaatattgc tcaaggagaa 540

ccaatcattg ctcactaccg tgccaaaggt ttggttcatg acatcgaagg taatcaagat 600

atcaatgatg tcttctcaga tattgaaaaa gtattgacaa atttgaaata a 651

<210> 452
<211> 378
<212> DNA
<213> Streptococcus pneumoniae

<400> 452
aaaggagaaa acatggctcg tattgctgga gttgatattc caaatgacaa acgcgtagta 60

atctcattga cttatgttta tggtatcgga cttgcaacat ctaagaaaat tttggctgct 120

gctggaatct cagaagatgt tcgtgtacgt gatcttacat cagatcaaga agatgctatc 180

cgtcgtgaag tggatgcaat caaagttgaa ggtgaccttc gtcgtgaagt aaacttgaac 240

atcaaacgtt tgatggaaat cggttcatac cgtggtatcc gtcaccgtcg tggacttcct 300

gtccgtggac aaaacactaa aaacaacgcc cgcactcgta aaggtaaagc tgttgcgatt 360

gctggtaaga aaaaataa 378

<210> 453
<211> 396
<212> DNA
<213> Streptococcus pneumoniae

<400> 453
gaggtaaaag tcttggctaa accaacacgt aaacgtcgtg tgaaaaagaa tatcgaatct 60

ggtattgctc atattcacgc tacatttaat aacactattg ttatgattac tgatgtgcat 120

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ggtaatgcaa ttgcttggtc atcagctggt gctcttggtt tcaaaggttc tcgtaaatct     180

acaccattcg ctgctcaaat ggcttctgaa gctgctgcta aatctgcaca agaacacggt     240

cttaaatcag ttgaagttac tgtaaaaggt ccaggttctg gtcgtgagtc agctattcgt     300

gcgcttgctg ccgctggtct tgaagtaaca gcaattcgtg atgtgactcc agtgccacac     360

aatggtgctc gtcctccaaa acgtcgccgt gtataa                               396
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<210>  454
<211>  402
<212>  DNA
<213>  Streptococcus pneumoniae

<400>  454
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atgcttcgcg atttgacaac tgacctttttg atcaacgaat caatcgtgac aactgaagct    120

cgtgctaaag aaatccgtaa aactgttgaa aaaatgatta ctctaggtaa acgtggtgat     180

ttgcatgcac gtcgtcaagc agctgctttc gtacgtaatg aaatcgcatc tgaaaactat     240

gatgaagcaa ctgataagta cacttctact acagcacttc aaaaattgtt ctcagaaatc     300

gcacctcgtt atgctgaacg taacggtgga tacactcgta tccttaaaac tgaatcacgt     360

cgtggtgatg cagcgccaat ggcgatcatc gaattagtat aa                        402
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<210>  455
<211>  414
<212>  DNA
<213>  Streptococcus pneumoniae

<400>  455
atgcctacaa ttaaccaatt ggttcgcaaa ccgcgtaaat caaaagtaga aaaatctaaa      60

tcaccagctt tgaacgttgg ttacaatagt cataaaaaag ttcaaacaaa cgtttcttca     120

ccacaaaaac gtggtgttgc aactcgtgtt ggaacaatga cacctaaaaa acctaactca     180

gcccttcgta aattcgctcg tgtacgtttg agcaacctta tcgaagttac tgcctacatc     240

ccaggtatcg gacacaactt gcaagagcac agcgtggtgc ttcttcgcgg tggacgtgta     300

aaagaccttc caggggtacg ttaccatatc gtccgtggtg cacttgatac tgcaggtgtt     360

aacgatcgta aacaaggccg ttctaaatac ggtactaaac gtccaaaagc ataa           414
```

```
<210>  456
```

<211> 477
<212> DNA
<213> Streptococcus pneumoniae

<400> 456
agagaaatga gtcgtaaaaa tagagctcca aaacgtgacg tattgccaga tccgctatac 60

aattcacaac tagttactcg tcttatcaac cgcgttatgc ttgatggtaa acgtggtact 120

gctgcttcaa tcgtttacgg tgcttttgag caaatcaaag aagctactgg caacgatgca 180

cttgaagtat ttgaaacagc tatggaaaac atcatgcctg tacttgaagt acgtgcacgt 240

cgtgttggtg gttctaacta ccaagtccca gttaaagttc gtccagaacg tcgtacaaca 300

cttggacttc gttggttggt aacaatcgct cgtcttcgtg gtgaacacac aatgcaagac 360

cgtcttgcaa aagaaatctt ggatgctgct aacaacactg gtgcagcagt taagaaacgt 420

gaagatactc accgtatggc tgaagctaac cgtgcattcg cacacttccg ttggtaa 477

<210> 457
<211> 930
<212> DNA
<213> Streptococcus pneumoniae

<400> 457
gaaaggactg aaaacatcat gactgaaaaa cttcaattaa ctaaatcaga tcgtaaaaaa 60

gtttggtggc gttcaacctt cttacaaggg tcttggaact ttgaacggat gcaaaacttg 120

ggctgggctt atacactcat tccagctatc aaaaaactct atactaaaaa agaagatcaa 180

atcgctgctc ttgagcgtca ccttgagttc ttcaacactc atccatacgt agctgctcca 240

gtcatggggg ttactcttgc gcttgaagaa gaacgtgcta acggtgtgga aatcgatgac 300

gctgctatcc aaggggttaa aatcggtatg atgggacctc ttgctggtat cggtgaccca 360

gtattctggt ttacagtacg cccaatcctt ggatctctcg gtgcttcact tgcccttact 420

ggcaatatct tggggccact cctcttcttt gttgcatgga acttgattcg tatgtcattc 480

ttgtggtatg ttcaagagat tggatacaag gctggatcag aaatcactaa agatatgtct 540

ggtggtatcc ttcaagatat cactaaagga gcttctatcc ttgggatgtt cattcttgct 600

gtccttgttc aacgctgggt aaatattaaa tttgctttcg atgtttctaa agttcaacta 660

gatgaaaagg cttatatcca ttgggataaa ttgccagaag ggtctaaagg tatccaagaa 720

gcattcgcac aagtaggaca aggattgtct caaactcctg aaaaagttac tactttccaa 780

caaaacttgg atatgttgat tcctggatta tcaggactac tccttacttt actttgcatg 840

tacttactta agaaaaaagt atctccaatc actattatcc ttgccctctt cgcagtgggt 900

attgtggcac atgttcttca catcatgtaa 930

<210> 458
<211> 831
<212> DNA
<213> Streptococcus pneumoniae

<400> 458
gccattattt atgaaaggat tttaaacatg tctattattt ctatggtttt agtagtcgtt 60

gtagccttct ttgcaggtct tgaaggcatc ctcgaccagt tccaatttca ccaaccactt 120

gtagcctgta cccttattgg gcttgtaaca ggtcacttgg aagcagggat tatcctcggt 180

ggatcgcttc aaatgattgc ccttggttgg tcaaatatcg gtgctgctat cgctcctgat 240

gctgcacttg cttctgtcgc tgctgccatt atcatggttc ttggtggtga ctttaccaag 300

actggtatcg gtgttgccca agcggttgct atccctcttg ctgtagctgg acttttcttg 360

acaatgattg ttcgtacaat ttcagttggt ttggttcata ctgcagatgc tgccgctaaa 420

aaaggtgact tcggcgctgt ggagcgtgcg catttcatcg cgctactttt ccaaggactt 480

cgtatcgcgc ttcctgcagc tcttctcctt atggtaccaa ctgaaactgt acaaagtatc 540

cttagtgcca tgccagactg gctcaaagat ggtatggcta tcggtggtgg tatggtcgtt 600

gccgttggtt acgccatggt tatcaacatg atggcaactc gtgaagtatg gccattcttc 660

gctcttggtt tcgttctcgc tgctgtgtca gatattactc taatcggatt cggtgctatc 720

ggcgttgcta tcgctcttat ctaccttcac ctttctaaaa ctggtggaaa tggtggcgga 780

ggagccgcaa cttctaacga cccaatcggc gatatcctag aagactacta a 831

<210> 459
<211> 1014
<212> DNA
<213> Streptococcus pneumoniae

<400> 459
aacaaaaaag gaggaatgac aataatgagt atcggaatca ttattgcgag ccacggcgaa 60

tttgctgcgg gtattcatca gtcaggatct atgatctttg gtgaacaaga aaaggttcaa 120

gttgtgacct ttatgccaaa tgaaggtcct gatgatctat acgctaagtt taataacgct 180

gttgctgcat ttgacgcaga agatgaggtt ctagttttgg ctgacctttg gagtggttct 240

ccatttaacc aagctagtcg cgtgatggga gaaaatcctg agcgtaagtt tgccatcatc 300
acaggactta acttaccgat gttgattcaa gcctacacag agcgcctcat ggacgctgct 360
gcaggtgtag aaaaagtcgc tgctaatatc attaaagaag ccaaagatgg catcaaagct 420
cttccagaag agctaaatcc agtcgaagaa gttgcaagcg ctgcagctgc tccagttgcc 480
caaactgcta tcccagaagg aactgttatc ggagacggta aattgaaaat caatcttgcc 540
cgtcttgaca cacgtctact tcacggtcag gttgcaactg cttggactcc agattcaaaa 600
gcaaatcgta tcatcgttgc ttcagataac gtggctaaag acgaccttcg taaagaattg 660
attaaacaag cagctccagg taatgtcaag gctaacgtgg ttccaattca aaaactgatt 720
gagatttcaa aagacccacg ttttggagaa acacatgccc ttatcttgtt tgaaacacct 780
caagatgccc ttcgtgccat cgaaggcggc gtgccaatca agactcttaa tgttggttct 840
atggctcact caacaggtaa aacattggtc aataccgttt tgtctatgga caaagaagac 900
gttgctacat ttgaaaaaat gcgtgacttg ggtgttgaat ttgatgtccg taaagtacca 960
aatgattcta aaaaagattt gtttgacttg attaacaaag ccaatgtcaa ataa 1014

<210> 460
<211> 1128
<212> DNA
<213> Streptococcus pneumoniae

<400> 460
tatacttcac atataaatac aagagagctc gtcacactcg actctgttga caaaaaatca 60
atccagtccc gttgtccctg ttctcggtca atatcaagga ggatagctat gaaagctgtt 120
gttgtaaatc cagaaagcac tggtgttgct attgaagaaa aagtactccg tccacttgaa 180
actggggaag cacttgtaga agttgaatac tgtggcgttt gccacaccga cctccacgtt 240
gctcatggtg actttggtca agtcccagga cgtgttcttg ggcacgaagg tatcggtatc 300
gttaaagaga ttgctccaga tgtgaaaagc cttaaagtcg gtgaccgcgt cagcgttgct 360
tggttctttg aaggatgtgg cacttgcgaa tactgtacaa ctggtcgcga aaccctttgc 420
cgtacagtga aaaatgctgg ctactcagta gacggtggta tggctgaaca atgtatcgta 480
actgctgact atgctgtcaa agttcctgac ggacttgatc cagcccaagc ttcttctatc 540
acatgtgctg gagtaacaac ctataaagct atcaaagaag caaaagttga accaggccaa 600
tgggttgttc tttacggtgc tggtggactt ggtaacctcg ctgttcaata cgctaaaaaa 660

gtattcaatg ctcatgttat cgcagtcgat atcaacaatg acaaacttgc ccttgcaaaa 720

gaagtaggcg ctgacattgt gattaacggc ctcgaagttg aagatgtagc tggactcatt 780

aaagaaaaaa ctgatggagg agctcattca gctgtcgtaa ctgctgtgtc taaagttgcc 840

ttcaaccagg ctgttgactc cattcgtgct ggtggtcgcg tcgtcgctgt tggtcttcct 900

tctgaaatga tggaactcag catcgttaaa acagtcctcg atggaatcca agtcatcggt 960

tctcttgtcg gaactcgtaa agacttagaa gaagccttcc aatttggtgc agaaggtctg 1020

gtagtcccag ttgttcaaaa acgtccagta gaagatgctg ttgccatttt cgacgaaatg 1080

gaaaaaggcc aaatccaagg acgtatggta ctcgacttca cccactaa 1128

<210> 461
<211> 477
<212> DNA
<213> Streptococcus pneumoniae

<400> 461
acaaaaatcg aactatatat aggagaaatc atgaacaaaa caacatttat ggctaaacca 60

ggccaagttg aacgtaaatg gtacgtagtt gacgcaactg atgtaccact tggacgtctt 120

tctgcagtag ttgctagcgt acttcgcgga aaaaacaaac caacatttac accacacact 180

gatacaggtg acttcgtgat tgttatcaat gctgaaaaag ttaaattgac tggtaaaaaa 240

gcaactgata aaatctacta cactcactca aaccacccag gtggattgaa acaaatctct 300

gcaggtgaac ttcgttctaa aaatgcagta cgtttgattg agaaatcagt taaaggtatg 360

cttccacaca atacacttgg acgcgctcaa ggtatgaagt tgaaagtatt tgttggagct 420

gagcacactc acgctgcaca acaaccagaa gttcttgaca tttcaggact tatctaa 477

<210> 462
<211> 396
<212> DNA
<213> Streptococcus pneumoniae

<400> 462
agtatgtcac aagcacaata tgcaggtact ggacgtcgta aaaacgctgt tgcacgcgtt 60

cgccttgttc caggaactgg taaaatcact gttaacaaaa aagatgttga agagtacatc 120

ccacacgctg accttcgtct tgtcatcaac caaccattcg cagttacttc aactgtaggt 180

tcatacgacg ttttcgttaa cgttataggt ggtggatacg ctggtcaatc aggagctatc 240

cgtcacggta tcgctcgtgc ccttcttcaa gtagacccag acttccgcga ttcattgaaa 300

cgcgcaggac ttcttacacg tgactcacgt aaagttgaac gtaagaaacc aggtcttaag 360

aaagctcgta aagcatcaca atttagtaaa cgttaa 396

<210> 463
<211> 834
<212> DNA
<213> Streptococcus pneumoniae

<400> 463
aggaggaagc acacgatgac tggatctaac aaattaacaa aacgtgatta tcttaaaacg 60

tctttgcggg cattcttttg tcaaaatgga tttaactata gtaactatca agggttggga 120

tatgccaatg tgatgtatcc tgctttgaaa aaacactatg gagaggatca ggaaggtttc 180

taccaagcct tggaagaaaa ctgtgaattc tataatacca acccacactt cctgcctttt 240

attaccagct tgcatcttgt aatgttggaa aatggccgtc cggcaaaaga aacacgtagc 300

atcaagatgg ccttgatggg accattggca ggtattgggg attctctttc tcaattctgt 360

ttagctccat tgttctcaac catcgcagct tcgtttgctc aagaaggctt ggttgtcggt 420

ccaatcttgt tcttccttgc gatgaatacg attttaacag cgattaaatt gtcaactggt 480

ctgtatggat acaaactagg aacaactgtg attgataaac taagcgaaca gatggcaacg 540

atttctcgta ttgccaatat tatcggtgta accgtaattg ctggtttggc agcgacatct 600

gttaagatta tggtgccgat tacctttgct gcaggggaag ttaaagcaga cgctaaacaa 660

agtatcgtaa gtattcaggg aatgcttgat aaggttgctc cagctcttct accagcccta 720

tttacacttt tagtttacta cttgatcaaa gaaaagaaat ggacaacata taaactcgtt 780

attttaacag ttatcatcgg aattatcgga agctggctta agattatagc ttaa 834

<210> 464
<211> 1533
<212> DNA
<213> Streptococcus pneumoniae

<400> 464
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gcttttagtt ctgaacaata tttgaattta caacgcgacc atattttgga gcgcattaac 120

caatttgacg gcaagctcta cttagagttt ggcggtaaaa tgttagaaga tttccacgct 180

gctcgtgtcc ttcctggtta tgaacctgac aacaaaatca agctcttgca agaattgaaa 240

gagcaggttg aggttgtgat tgccattaat gctagcaaca ttgaacattc caaagcacgt 300

ggcgacttag gcatttctta tgaccaagaa gttcttcgtt tgattgataa attcaatgaa 360

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aaatttgaaa ccttccctgt ttggaatctt ccccttcatc atccagttaa cttggcttat 720

gaagctgcca cagctgacct tgatgatgtc aacatgattg accccttcca tcttcaaacc 780

tatggagaaa ccactgtcaa ctacaaccgt gatatcgaaa tcttcccagt gctcaaacgc 840

atgttggaac gtattctcgg aaaatcacca tacgcttcac cgacagatat gggtgtcaac 900

atggttggtt tcgctattac agatgacgag gccgctgtcg aagcttctaa acaagaaatc 960

atccgccgtt actatcaaac agttcttgac ttcaaagctg aaaaagttgg cgaagctgcc 1020

gtcaagaaaa ttgagttgct catgaacgac ctcggtatca cacctgcaga ccgtaaggtt 1080

gctgtcgttg cgcgccaaaa agcagaagaa actggtggac cagccctagc ctttgaattg 1140

ccaaatgggg aaatcatcac tggtaagaac tcagaactct ttggtcctac agccgctgcc 1200

ttgatcaacg ccatcaaaaa atcagctgac atcgctaaag aagtaaaact aatcgagcct 1260

gaagttgtta agccaatcca aggtcttaaa atcgatcatc tcggtagccg caatccacgc 1320

cttcattcaa atgaaatcct gattgcactt gctatcacag ctacagaaaa tcctgatgct 1380

gcccgcgcta tggaagaact cggcaacctc aaaggaagcg aagcccactc aaccatcatc 1440

ttgactgatg aagacaagaa tgtccttcgt aaactgggta tcaacgtaac ctttgaccca 1500

tactaccaat acgaccgctt atatcgtaag taa 1533

<210> 465
<211> 2166
<212> DNA
<213> Streptococcus pneumoniae

<400> 465
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agcttggtta tcgcagccat tgtcttaggc ggaggagttt ttttctacta cgttagcaag 120

gctcctagcc tatccgagag taaactagtt gcaacaactt ctagtaaaat ctacgacaat 180
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agtttacctc agttagcctt gctggctgga atgcctcagg caccaaacca atatgacccc 660
tattcacatc cagaagcagc ccaagaccgc cgaaacttgg tcttatctga aatgaaaaat 720
caaggctaca tctctgctga acagtatgag aaagcagtca atacaccaat tactgatgga 780
ctacaaagtc tcaaatcagc aagtaattac cctgcttaca tggataatta cctcaaggaa 840
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tacacaaatg tagaccaaga agctcaaaaa catctgtggg atatttacaa tacagacgaa 960
tacgttgcct atccagacga tgaattgcaa gtcgcttcta ccattgttga tgtttctaac 1020
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ggaacctcta actatacaga cgaggaaatt gaaaaccaca tcaagacctc tcaatttgta 1740
gcacctgatg aactatttgc tggctatacg cgtaaatatt caatggctgt atggacaggc 1800

tattctaacc gtctgacacc acttgtaggc aatggcctta cggtcgctgc caaagtttac 1860

cgctctatga tgacctacct gtctgaagga agcaatccag aagattggaa tataccagag 1920

gggctctaca gaaatggaga attcgtattt aaaaatggtg ctcgttctac gtggaactca 1980

cctgctccac aacaaccccc atcaactgaa agttcaagct catcatcaga tagttcaact 2040

tcacagtcta gctcaaccac tccaagcaca aataatagta cgactaccaa tcctaacaat 2100

aatacgcaac aatcaaatac aacccctgat caacaaaatc agaatcctca accagcacaa 2160

ccataa 2166

<210> 466
<211> 351
<212> DNA
<213> Streptococcus pneumoniae

<400> 466
caagcgagaa tggagagaga catggcaagt attatttttt cagcgaaaga tatttttgaa 60

caagagtttg gacgtgaggt ccgtggctat aataaagtag aagttgacga gtttttagac 120

gatgtcatca aggactatga aacctatgct gccttggtca agtcacttcg tcaggaaatt 180

gcggatttga aggaagaatt aactcgtaaa ccgaaacctt caccagttca agcagaaccc 240

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<212> DNA
<213> Streptococcus pneumoniae

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<213> Streptococcus pneumoniae

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<213> Streptococcus pneumoniae

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gcgtatgtca tggaagaaat caagagataa 2910

<210> 477
<211> 912
<212> DNA

<213> Streptococcus pneumoniae

<400> 477
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caagcagccc gtgacaacgg ttatgcagtt ggtggattta acacaaacaa ccttgagtgg 120

actcaagcta tcttgcgcgc agcagaagct aaaaaagctc cagttttgat ccaaacttca 180

atgggtgctg ctaaatacat gggtggttac aaagttgctc gcaacttgat cgctaacctt 240

gttgaatcaa tgggtatcac tgtaccagta gctatccacc ttgaccacgg tcactacgaa 300

gatgcacttg agtgtatcga agttggttat acttcaatca tgtttgacgg ttcacacctt 360

ccagttgaag aaaaccttaa attggctaaa gaagttgttg aaaaagcaca cgctaaaggt 420

atctcagtag aagctgaagt tggtactatc ggtggtgaag aagatggaat catcggtaaa 480

ggtgaattgg ctccaatcga agacgctaaa gcaatggttg aaactggtat cgacttcttg 540

gcagctggta tcggtaacat ccacggtcct tacccagtaa actgggaagg tcttgacctt 600

gaccacttgc aaaaattgac agaagctctt ccaggattcc caatcgtatt gcacggtgga 660

tcaggtattc ctgatgagca aatccaagca gctatcaaac ttggtgttgc caaagttaac 720

gttaacacag aatgccaaat cgcattcgct aacgcaactc gtaaatttgc tcgtgactac 780

gaagcaaacg aagcagaata cgacaagaaa aaactcttcg acccacgtaa attcttggct 840

gacggtgtaa aagctatcca agcatcggtt gaagaacgta tcgacgtatt cggttcagaa 900

ggtaaagcat aa 912

<210> 478
<211> 468
<212> DNA
<213> Streptococcus pneumoniae

<400> 478
aaatctctaa ttaccgccaa aaccacaaag gaggatttaa aaatggctaa aaaagtcgaa 60

aaacttgtaa aattgcaaat ccctgctggt aaagctacac cagctccacc ggttggacct 120

gctcttggtc aagctggtat caacatcatg ggattcacaa aagagttcaa cgctcgtaca 180

gctgaccaag ctggtatgat cattccagtt gttatctcag tttacgaaga taaatcattt 240

actttcgtta cgaaaacacc accagctgct gttcttttga aaaaagctgc aggtgttgaa 300

aaaggatcag gtacacctaa taaaactaaa gttgctacag ttactcgtgc acaagtacaa 360

gaaattgcag aaactaagat gccagatttg aacgcagcaa acgtagagtc tgcaatgcgt 420

atgatcgaag gtactgctcg ttctatggga ttcactgttg ttgactaa 468

<210> 479
<211> 693
<212> DNA
<213> Streptococcus pneumoniae

<400> 479
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gcatacagtg tagaagaagc tgtagcactt gcaaaagaaa ctaactttgc aaaatttgat 120

gcaactgtag aagttgctta caacttgaac atcgacgtta aaaaagctga ccaacaaatc 180

cgtggagcaa tggtattgcc aaacggtact ggtaaaactt cacgtgttct tgttttcgca 240

cgtggtgcaa aagctgaaga agcaaaagct gctggtgcag actttgttgg tgaagatgac 300

cttgttgcta aaatcaacga cggttggttg gacttcgacg tagttatcgc tacacctgat 360

atgatggctc ttgttggacg tcttggacgt gtccttggac cacgtaactt gatgccaaac 420

cctaaaactg gtactgtaac aatggatgtt gctaaagcag ttgaagagtc taaaggtggt 480

aaaatcactt accgtgctga ccgtgcaggt aacgttcaag caatcatcgg taaagtatca 540

tttgaagctg aaaaattggt tgaaaacttt aaagctttca acgaaacaat ccaaaaagca 600

aaaccagcta cagctaaagg aacttacgta acaaacttga ctatcacaac tactcaaggt 660

gttggtatca aagttgacgt aaactcactt taa 693

<210> 480
<211> 1866
<212> DNA
<213> Streptococcus pneumoniae

<400> 480
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attatcgccc acgttgacca cggtaaaaca accctggttg acgaattatt gaaacaatca 120

gaaacgcttg atgcacggac tgaattggca gagcgtgcta tggactcaaa cgatatcgaa 180

aaagagcgtg gaattaccat ccttgctaaa aatactgccg ttgcttacaa cggaactcgt 240

atcaacatta tggacacacc aggacacgcg gactttggtg gagaagttga gcgtatcatg 300

aaaatggttg acggtgttgt cttggtcgta gatgcctatg aaggaaccat gccacaaact 360

cgtttcgtat tgaaaaaagc cttggaacaa gaccttgtcc caatcgtggt tgttaacaaa 420

atcgataagc catcagctcg tccagcagaa gtagtggatg aagtcttgga acttttcatc 480

gagcttggtg cagatgacga ccagcttgat ttcccagtgg tttatgcttc agcgatcaac 540

ggaacttctt cattgtcaga tgatccagct gaccaagaag cgactatggc accaatcttt 600

gacacgatta tcgaccatat cccagctcca gtagataact cagatgagcc tttgcagttc 660

caagtgtcac ttttggacta caatgacttc gttggacgta tcggtatcgg tcgtgtcttc 720

cgtggtacag ttaaggttgg ggaccaagtt accctttcta aacttgacgg tacaactaaa 780

aacttccgtg ttacaaaact cttcggtttc tttggtttgg aacgtcgtga aatccaagaa 840

gccaaagcgg gtgacttgat tgccgtttca ggtatggaag acatctttgt cggtgaaacc 900

atcactccga cagatgcagt agaagctctt ccaatcctac acatcgatga gccaactctt 960

caaatgactt tcttggtcaa caactcacca tttgctggta aagaaggtaa atgggtaact 1020

tctcgtaagg tggaagaacg cttgcaggca gaattgcaaa cagacgtttc ccttcgtgtt 1080

gacccaactg attcaccaga taaatggact gtttcaggac gtggagaatt gcacttgtca 1140

atccttatcg aaacaatgcg tcgtgagggc tatgaacttc aagtatctcg tccagaagtt 1200

atcgtaaaag aaatcgacgg tattaaatgt gaaccatttg aacgtgtaca aatcgacact 1260

ccagaagaat accaagggtc tgttatccaa agcctttctg aacgtaaagg tgaaatgttg 1320

gatatgattt caactggtaa tggtcaaact cgtttggtct tccttgttcc agcgcgtggt 1380

ttgattggat actcaactga gttcttatca atgactcgtg gttacggtat catgaaccat 1440

accttcgacc aatacttgcc attgattcca ggggaaattg gtggacgtca ccgtggtgcc 1500

cttgtttcta tcgatgctgg taaggctaca acttactcaa tcatgtctat cgaagaacgt 1560

ggtacgatct ttgtcaaccc aggtactgag gtttatgaag gaatgatcat cggtgaaaac 1620

tctcgtgaaa atgacttgac agttaacatc acgaaggcaa aacaaatgac caacgttcgt 1680

tcagctacta aggaccaaac agctgttatc aagacgcctc gtatcttgac acttgaagag 1740

tctcttgagt tcttgaacga cgatgagtac atggaagtaa cgcctgagtc tatccgtttg 1800

cgtaaacaaa tccttaacaa agcagagcgt gagaaagcta acaagaagaa aaaatcagct 1860

gaataa 1866

<210> 481
<211> 1200
<212> DNA
<213> Streptococcus pneumoniae

<400> 481
aaaaagagtt attatagttg tatagtaaaa agcaaacgct tacttaatcg aggaggacag 60

tttatgtcat acaaaacaag caatgcagaa ggtcatgtag acttcatcaa tacctatgat 120

ttggagccaa tggcgcaaca agttattcct aaagcagcat ttggctatat cgctagtggg 180

gcggaagata ctttcacttt aagagagaat atccgtgcct ttaaccacaa gctcatcgtt 240

cctcatacac tttgcaatgt agaaaatcca agtacagaga ttgaatttgc aggtgaaaaa 300

ctatcttctc caatcattat ggcacctgtt gcggctcata aattggcaaa tgaacagggg 360

gaagtggcga ctgcgcgtgg tgtgcatgag tttggttctc tttatacaac cagttcttac 420

tctactgttg accttccaga gatttctgaa gccctccaag ggacacctca ttggtttcaa 480

ttttacttta gtaaggatga cggtatcaac cgccacatca tggaccgtgt gaaggctgaa 540

ggttataaag cgattgtctt gacggcagat gctactgtag gggggaatcg tgaagtggat 600

aagcgtaatg gttttgtctt cccagttggc atgccgattg ttgaagaata cctgccagaa 660

ggtgctggta aatcaatgga ctttgtttac aaatcagcta aacaacgctt gtctccacgc 720

gatgtagaat ttatcgctga atactctggt cttcctgtgt atgtcaaggg accacaatgc 780

cgtgaggacg ttgaacgttc gcttgctgca ggagcttctg gtatctgggt aaccaaccac 840

ggtggtcgtc aaatcgacgg tggaccagct gcctttgact cgcttcaaga agtggcagaa 900

gcagttgata gacgtgtgcc gattgtcttt gactctggtg ttcgtcgtgg tcaacacgtc 960

tttaaagcct tggcatcagg agcagacttg gttgctattg gacgccctgt catctatggc 1020

ttggctctcg gtggtagtgt cggtgtgcgt caagtctttg aacacttgaa tgcggaattg 1080

aagacagtta tgcaattgtc tggaactcag accattgaag atgtcaaaca cttcaagctc 1140

cgtcacaatc catacaaccc aaccttccca gttgaccctc gtgacttaaa attgtattga 1200

<210> 482
<211> 1011
<212> DNA
<213> Streptococcus pneumoniae

<400> 482
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atcgacatgt cagaaccatt atttttacaa tcagttatgc aagaaaaaat ctggggtgga 120

gccaagctac gtgatgagtt tggctacgac atcccaagtg aaaaaatcgg agaatattgg 180

gccatctcag cccatccaaa tggagtctct aaagttgcca atggtcgtta cgagggaaca 240

gatcttgcta ctttgtatgc ggaacaccgt gaattatttg gcaatcgtcc agaacctgta 300

tttccacttt tgaccaagat cctcgatgcc aacgactggc tcagtgtcca agttcaccca 360

gacgatgctt atggactcga gcatgaaggc gaactcggaa aaacagaatg ctggtacatt 420

atcgcagcgg atgaaggttc agagattatc tacggtcaca atgccaagtc aaaagaagaa 480

ctccgccagc aaatcgagga caagaactgg gatgacttgt tgaccaaagt ccctgttaag 540

gctggagatt tcttctatgt accaagcggg actatgcacg ctatcggggc gggtatctta 600

atccttgaaa cccagcagtc tagcgatacc acctatcgcg tctatgactt tgaccgcaag 660

gatgacaaag gcaacttgcg tgaacttcat cttgaaaaat ccatcgatgt cttgaacatt 720

ggtgagccag caaatagccg tcctgtaact gttaaagcag atgatttgcg ttccactctc 780

cttgtatcta atgatttctt cgcagtttac aagtgggaaa ttactggaaa agttgacttt 840

gaaaagacag ctgactacag cttattgagt gtcttggctg gtcaaggtca gctaactgtt 900

gacgggaaaa attatccaat tcaaaaaggc agccacttta tcctaccaag tgatgttgaa 960

gcttggactc tggaagggca aggtttggaa ttgattgtta gccatccata a 1011

<210> 483
<211> 864
<212> DNA
<213> Streptococcus pneumoniae

<400> 483
caaagatgga gaatttctat gacttggaag attattgctg actctggttg tgattatcgt 60

caactgccaa caccagctat taacacaacc tttgtaagtg tccccttaac cattcaagta 120

gctgatcagg tctttgttga tgacgccagt ctcgatattg accaaatgat ggaaaccatg 180

tatgcaactg cagaagcttc aaaatcggct tgtccaagcc cagatgacta tttgcgagca 240

tttgaaggtg ccaaaaacat tttcctagta accatcacag gtaccctttc tggcagtcac 300

aatagtgctc aactagcaaa gaatatttat ctggaagacc atcctgacac taagattcat 360

gtgattgata gtttatctgc tggtggtgaa gttgacctac tcgtagaaaa attgaatgac 420

ttgattgacc agggcttgtc ttttgaagaa gtggttgaag ctatcaccgc ctatcaagaa 480

aaaactaagt tgctctttgt cctagccaaa gtcgataact tggtgaagaa cggccgtttg 540

agcaagctta tcggtacggt cgttggcctt ctcaacattc gtatggtcgg aaaagctagt 600

gaaactggga ctctcgaatt gctacaaaaa gcaaggggat caaagaaatc agttcaagct 660

gcctatgatg agttagtaaa agctggatat gctggtggcc gtattgtcat ggcccaacgc 720

aataacgaaa aatgttgtca acagctctca gagcgaatcc gtgaaacctt cccacaagcg 780

gatattaaaa ttctaccaac ctctggtctc tgcagtttct atgcagaaga gggcggtttg 840

ctgatgggct atgaaattga ttaa 864

<210> 484
<211> 681
<212> DNA
<213> Streptococcus pneumoniae

<400> 484
accgtttttt ggtataataa gaagaataaa ttgaaagaag gaattccaaa aatgggaaaa 60

attgaagtta ttaatcaccc actgattcaa cacaaattgt caatcttgcg tcgtacagat 120

acttctacaa aagcttttcg tgagctagta gatgagattg caatgttgat ggggtatgaa 180

gtacttcgtg atcttccact agaagatgtg gaaatcgaaa caccaattac aaaaacagtt 240

caaaaacaat tggcaggtaa gaaattggcc atcgtcccaa tcttgcgtgc aggtatcggg 300

atggttgatg gtctcttgaa cttggttcca gctgctaaag ttggccacat cggtatgtac 360

cgtgatgaag aaacacttca accagttgaa tacttggtga aattgcctga ggacattgac 420

caacgtcaaa tttttgtagt agacccaatg ttggcaacag gtggctcagc aatcttggct 480

gttgattctc ttaaaaaacg tggcgcatca aatatcaaat ttgtctgcct tgtatctgct 540

ccagagggtg taaaagccct tcaagaagct catccagatg tagaaatctt tacagcagcc 600

ttggatgaac gtttgaacga acacggttat atcgttccag gtcttggaga tgctggagac 660

cgcttgttcg gtacaaaata a 681

<210> 485
<211> 951
<212> DNA
<213> Streptococcus pneumoniae

<400> 485
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tctgaaacag ctgaggctgc ttcagttaca actaaccttg taacccaatc taaagtatca 120

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gatgctatcg ttgttcctgg ttactataat gaggctggta aaattgtaaa ccaagcgcgt 540

ggcatgggaa ttgacaaacc aatcgttggt ggtgatggat tcaacggtga ggagtttgta 600

caacaagcaa ctgctgaaaa agcatcaaac atctacttta tctcaggctt ctcaactact 660

gtagaagttt cagctaaagc taaagccttc cttgacgctt accgtgctaa gtacaatgaa 720

gagccttcaa catttgcagc cttggcttat gattcagttc accttgtagc aaacgcagca 780

aaaggtgcta aaaattcagg tgaaatcaag aataaccttg ctaaaacaaa agattttgaa 840

ggtgtaactg gtcaaacaag cttcgatgca gaccacaaca cagtcaaaac tgcttacatg 900

atgaccatga acaatggtaa agttgaagca gcagaagttg taaaaccata a 951

<210> 486
<211> 1218
<212> DNA
<213> Streptococcus pneumoniae

<400> 486
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gtatctgagg ggcatccgga taagattgca gaccaaattt cagatgcgat tttggatgct 120

attttagcaa aggatccaga ggcgcacgtt gctgctgaaa cagctgtata tactggttct 180

gtccacgttt ttggtgaaat ttctacaaat gcctatgtgg atattaaccg tgtggttcgt 240

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gggctcatgt ttggatttgc agtagatgaa acagaagagc ttatgccatt gccaattgca 480

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cgtgtagata cagtcgttat ttctactcag catgatccag aggccactaa tgaacaaatc 660

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tcaggtttga ctggtcgtaa gattattgta gatacttatg gtggctactc tcgtcatggt 840

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cacatgggac gtacagatat tgatcttcca tgggaacgtt tggataaggt agatgctttg 1200

aaagaagcag taaaataa 1218

<210> 487
<211> 291
<212> DNA
<213> Streptococcus pneumoniae

<400> 487
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aaacctttct accgtatcaa cgtagcagat tcacgttcac cacgtgacgg acgtttcatc 120

gaaacagttg gaacttacaa cccacttgtt gctgaaaacc aagtaacttt gaaagaagac 180

cgcgttcttg catggttggc taatggagct caaccttcag acacagtacg taacatcctt 240

tcaaaagaag gcgtattgaa aaaattccac gattctaaat tttcaaaata a 291

<210> 488
<211> 414
<212> DNA
<213> Streptococcus pneumoniae

<400> 488
acattatcaa ctgacagtag aagaagaaaa aatgctggca gaaatcaaag aaaacaaaga 60

ataaaggaga aacctatgca agtaatcaaa cgtaatggcg aaattgctga atttaatcca 120

gataagattt accaagccat cttgaaggca gcccaaactg tttatgtttt gacagatgat 180

ttgcgtcaaa atcttgctca agtcactaag aaggtagttt tggatttaca agaagccaag 240

gtggaacgtg cgactatcag tatgattcaa tctatggttg aacatcgttt attgggcgca 300

ggttacatta ccattgcaga acactacatt tcctatcgtt tacaacgtga cttggaaaga 360

agtggttatg gagatcatat cgcagttcat ttacattttg aacaaattcg ctaa 414

<210> 489
<211> 2268
<212> DNA
<213> Streptococcus pneumoniae

<400> 489
ggtagatgta tgctttgtca aaactgtaaa attaacgact caacaattca tctttacacc 60

aatctcaatg gaaaacaaaa acaaattgac ctctgtcaaa actgctataa gattatcaaa 120

acagatccta acaatagcct cttcaaaggt atgacggatc tgaacaatcg tgacttcgat 180

ccctttggtg atttcttcaa tgatctaaac aatttcagac cttctagcaa tactcctcct 240

attcccccaa cccaatcagg tggaggttac ggtggaaacg gcggttatgg ttcccaaaat 300

cgtggatctg ctcaaactcc gccacctagc caagaaaaag gcctgctgga agaatttggt 360

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ggtgaacctg gtgtcggaaa aacggccgtt gtcgaaggtc tagctcagaa aattgtcgat 540

ggcgatgtgc cacataaact ccaaggtaaa caagtcatcc gtctggatgt ggttagctta 600

gttcaaggaa cggggattcg aggacaattt gaagaacgca tgcaaaaact catggaagaa 660

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ggttctgcga gtgatggtaa tatggacgca ggaaatatcc tcaagccagc ccttgctcgt 780

ggagaactgc aactagtcgg tgctactacc ctcaatgaat accgtatcat tgaaaaggat 840

gctgccctcg agcgtcgtat gcagcctgtt aaagtcgatg aaccaacggt ggacgaaaca 900

atcactattc tcaaagggat tcaaaagaaa tacgaagatt accaccacgt tcaatataca 960

gatgctgcga ttgaagcagc tgcaactctt tccaatcgct acatccaaga tcgcttcttg 1020

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gctacacgag aagaagattt tgagaaggcg gcctacttcc gcgaccagat tgccaagtat 1200

aaggaaatgc aaaagaaaaa gatcacagac caggatactc ctagcatcag cgagaaaact 1260

attgagcaca ttatcgagca gaaaaccaat atccctgttg gtgatttgaa agagaaagaa 1320

caatctcaac tcatccatct agccgaagat ctcaagtctc atgttattgg tcaagatgat 1380

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gaatacatgg aaaaacatag tgtggctaag ttggtcggcg ctcctccagg ttatgttggc 1620

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ctcgatgaag tggaaaaagc tcacccagat gttatgcaca tgtttcttca agtcttggac 1740

gatggtcgtt tgacagacgg gcaaggacgc accgttagct tcaaggatgc catcattatc 1800

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gaaggacgta ccaattctgt cctcggtgaa ctcggtaact tctttagccc agagtttatg 1920

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gtcgagctca tgctagcaga tgttaacaag cgcctctcta gcaacaacat tcgtttggat 2040

gtaactgata aggtcaagga aaagttggtt gacctaggtt atgatccaaa aatgggagca 2100

cgcccacttc gtcggactat tcaagactat attgaggaca caatcactga ctactacctt 2160

gaaaatccaa gcgaaaaaga tctcaaagca gttatgacta gcaagggaaa cattcagatt 2220

aaatctgcca aaaaagctga agttaaaagt tctgaaaaag aaaaataa 2268

<210> 490
<211> 1203
<212> DNA
<213> Streptococcus pneumoniae

<400> 490
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gttgaaggtg tcttgactct tcgcgaattg acaaacgatc gtgatgcaga tatcaatgac 180

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cgtttcgtac gtaacgctga gcgttttgta ggtcaagaat ttgatactaa aatcaaagaa 480

gttaacgcta aagaaaaccg cttcatcctt tcacgtcgtg aagttgttga agcagctact 540

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<210> 491
<211> 1443
<212> DNA
<213> Streptococcus pneumoniae

<400> 491
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atctacgtgc caaaaggtgt caaggtagat attccacttc aaacttattt ccgtatcaat 660
aacgaaaata taggtcagtt cgaacgtacc ttgattatcg ttgatgaggg agcaagcgtc 720

tactacgtag aaggatgtac agcaccaaca tattcaagca atagcttaca cgctgccatt 780

gtagaaattt ttgctttgga cggagcttat atgcgttata caactatcca aaactggtct 840

gataacgtct ataacttggt aacaaagcgt gctaaggctc aaaaggatgc cactgttgag 900

tggattgatg gaaacttggg tgccaaaacg actatgaaat atccatctgt ttaccttgat 960

ggagaaggag cgcgtggtac catgctctct atcgcctttg ctaatgcagg gcaacaccaa 1020

gacacgggtg ctaagatgat tcacaatgct ccacatacca gctcgtctat tgtgtctaaa 1080

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tcagatacta ttccatttaa tgaaattcac aactcgcaag tggctttgga acacgaagcc 1260

aaagtatcta agatttcaga agagcaattg tattatctca tgagccgtgg attgtcagaa 1320

tctgaggcaa ctgaaatgat tgtcatggga tttgtagaac cctttacaaa agaacttcca 1380

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taa 1443

<210> 492
<211> 1254
<212> DNA
<213> Streptococcus pneumoniae

<400> 492
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gcaaatactg gtaaaattct ctatgagaag gatgcaacgc aacctgtcga aattgcttcc 180

ataacaaaat tgattactgt ttatctggtc tatgaagctt tggaaaacgg aagtattacc 240

ctctccactc ctgtagatat ttctgattat ccttatcaat tgacgacaaa ttctgaagcc 300

agtaatattc ctatggaggc ccgtaattat actgtcgaag agttgcttga agcaactctg 360

gtatctagtg ccaacagcgc cgctattgcc ctagctgaga aaattgctgg ctcagaaaaa 420

gatttcgtcg atatgatgcg ggcaaaactc ttggaatggg gaattcagga tgccactgtt 480

gtcaatacga caggtcttaa caatgaaact ctaggggata acatttaccc aggttctaaa 540

aaagatgagg aaaataagct tagtgcttat gatgtcgcta tcgttgctcg caacctcatc 600

aaaaaatacc cacaagtctt agaaatcacc aaaaaacctt cttctacttt tgctgggatg 660

acaatcactt caaccaacta catgttagaa ggtatgcctg cttaccgtgg tggttttgat 720

gggctaaaaa caggaacaac agataaggct ggagagtctt ttgttggtac tactgtcgaa 780

aaaggcatga gagtcatcac agttgtttta aatgcagatc atcaagacaa taatccttac 840

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aaaatcgttc aacaaggcga tgcctatcaa gatagcaaag cccctgtaca agatggaaaa 960

gaagatacag taactgcagt ggctccagag gatatctatc taatcgaacg tgttgggaat 1020

caatcttccc aatctgttca attcacacct gattccaaag caatcccagc accacttgaa 1080

gctggaacag tggttggcca tttgacttat gaagacaagg acttgattgg tcaaggttac 1140

atcaccacag agcgccctag tttcgaaatg gtagcagaca agaaaattga aaaagccttc 1200

ttcttaaaag tttggtggaa tcagtttgtc cgctttgtta acgagaaatt ataa 1254

<210> 493
<211> 1074
<212> DNA
<213> Streptococcus pneumoniae

<400> 493
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accaatatga aacgtattgc tgttttgact agtggtggag acgcccctgg tatgaacgct 120

gccatccgtg cagttgttcg tcaagcaatt tcagaaggaa tggaagtttt tggtatctat 180

gacggatatg ctggtatggt tgccggtgaa attcatcccc tagatgcagc ttcagtaggg 240

gacatcattt ctcgtggtgg tactttcctt cactcagctc gttacccaga gttcgctcaa 300

cttgaagggc aacttaaagg gattgagcaa ttgaaaaaac acggaattga aggtgtagtt 360

gttatcggtg gtgacggatc ttaccacggc gctatgcgtt tgactgaaca tggcttccca 420

gctattggtc ttccaggtac aatcgataac gatatcgttg gtactgactt tacaatcggt 480

tttgacacag cggttactac tgccatggac gctatcgata agattcgtga tacatcatca 540

agtcaccgtc gtactttgt aatcgaagtt atgggacgta acgctggtga tatcgctctt 600

tgggctggta ttgcaactgg tgctgatgaa atcatcatcc ctgaagcagg cttcaagatg 660

gaagatatcg tagcaagcat caaagctggt tatgaatgtg gtaaaaaaca caatattatc 720

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gatacaagcg accttcgtgt aacagaactt ggacatattc aacgtggtgg ttctccaact 840

atcggcaata tcttggccta tatttccatc ggcgaccgca tccaagacat cgagcgcttg 1140

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ggagaatata ttcagcccga gttagtgctg tctccgcaag aagccttcta ttcagaaaga 1260

aaaagtttaa ctttggatga ttctgttgga caggtctgtg gagaatttgt tatgtgttac 1320

cctccaggta ttcctatctt ggctcctggt gaacgcatta cacgagaaat tgtcgactat 1380

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catatcaacg ttattaagag aaagacaaac tataagaaaa gtcaatag 1488

<210> 496
<211> 861
<212> DNA
<213> Streptococcus pneumoniae

<400> 496
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tttgggaaaa tactgatttt aaatggccat gtcttgttct cagatgcgga tgatttcgtc 180

tacaatgaaa tgaccgttca cgttcccatg gctgtccacc caaatccaaa gaaagtattg 240

gttattgggg gtggtgacgg cggtgttgcc caagtattaa ccctctatcc tgaactggag 300

caaattgata ttgtggaacc ggatgagatg ttggtcgagg tctgtcgtga gtatttccca 360

gactttgctg cagggctaga tgatcctcgt gttaccattt actaccaaaa tgggctacgc 420

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ggccatacgg aaggactctt taccaaggaa ttctacggca atagttatcg agctctgaag 540

gaagacggca tcatgattta ccagcatggg agtcccttct ttgacgagga tgagtcggcc 600

tgccgaagca tgcaccgcaa ggtcaatcaa gcctttccaa tcagtcgggt ttatcaggcc 660

catattccaa ctagcccagc tggctattgg ttgtttggat ttgcatcgaa aaaataccac 720

cctgtcaaag attttgacaa ggaaggctgg aaaaaacgcc agcttttcac agaatactac 780

actgcaaact tacacgtggg agcctttatg ttgcccaagt atgttgagga cattttagaa 840

gaagaggaag gaaaaaaatg a 861

<210> 497
<211> 885
<212> DNA

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ggtatcggtg gtgttgcggt tggtattcgt aacgaaaaaa tggttgaaaa tccaattctt 960
ggtactgcag aagaaggggc attgtttagc cttactgcag aaggtaagat tgtggttaac 1020
aacccacaca aagccgatat tgagctatct agcttgaata agagcttgtc ataa 1074

<210> 494
<211> 1545
<212> DNA
<213> Streptococcus pneumoniae

<400> 494
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tactggggtg aaaaacttga tgttgaagct tcagctaaaa acattgctaa attgattgaa 180
gctggtgcta acacattccg attcaacttc tcacacggcg accaccaaga acaaggtgag 240
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tacaaaactg gtgaaaaaat tcgtgttgca actaaacaag gaatcaaatc aactcgtgaa 420
gtgattgcgt tgaacgttgc tggtgctctt gatatctatg atgatgttga agttggtcgt 480
caagttttgg ttgacgatgg taaacttggt cttcgtgtgg ttgctaaaga tgatgcaact 540
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gcttctgctg ttaaagatgc tactagctca atggatatca aattggttgt aactcttact 1260

aagacaggtc atactgcacg tttgatttct aaataccgtc caaatgctga catcttagca 1320

ttgacatttg acgaattgac agaacgtggc ttgatgttga actggggtgt tatcccaatg 1380

ttgacagatg ctccatcttc aactgacgat atgttcgaaa tcgctgaacg taaagcggta 1440

gaagcaggtc tcgttgagtc aggcgatgat atcgttatcg ttgctggtgt gccagtagga 1500

gaagctgttc gcacaaacac aatgcgtatc cgcacagtac gttaa 1545

<210> 495
<211> 1488
<212> DNA
<213> Streptococcus pneumoniae

<400> 495
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aagttacgca agaaaaggat tgttcccttt gatgttccag gtcacaagcg tggacgggga 120

aatccagaac ttgtcgaact cttaggagaa aaatgtgtag gcattgatgt caattcgatg 180

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cagactatga ttctggcaac ctgcaaggca ggagataaga ttattctgcc acgaaatgtc 360

cataaatctg ctatcaatgc gttggttcta tgtggtgcca ttcccatcta tatcgagatg 420

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gatgaagccc acggagcgca tttgcatttc actgataaac ttccaatttc tgctatggat 660

gcaggggctg atatggcagc agtttccatg cataagtctg gtgggagttt gacccaaagc 720

tccattttac ttatcgggga gcagatgaat tctgaatacg ttcgtcagat aattaacctg 780

acccagtcta catctgcctc ttacttgttg atggctagtt tggatatttc acgtcgcaac 840

ttggcccttc gtggtaaaga gtcgtttgag aaagtcattg agctatctga gtatgcccgc 900

cgtgaaatca atgctatcgg tggctactat gcctactcaa aagagttaat agacggtgtt 960

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<213> Streptococcus pneumoniae

<400> 497
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gcaacaaata tccaaaccgc agagcgttta gtacgtcagg ctgctgagca aggagcccaa 120

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tactaccagt atgcccaatc tgtagcggaa aatactgcca ttcagcattt taaggtgatt 240

gctaaggaac tacaagttgt tttaccaatc agtttctatg aaaaagatgg taatgtcttg 300

tataactcta ttgccgtcat tgatgcagat ggggaagtgc tgggcgttta tcgaaagacc 360

catataccag atgaccatta ttatcaagaa aaattctatt tcacgcctgg taacactggt 420

ttcaaggtct ggaatactcg ctatgctaag attggtatcg gtatctgttg ggatcaatgg 480

ttccctgaaa cagcgcgctg tcttgcattg aatggtgctg aattgctctt ttatcctaca 540

gctatcggtt cagagccaat tttggataca gatagttgtg gtcactggca acgtactatg 600

caagggcacg cagcagcgaa tattgttcca gtcatcgcag ccaatcgtta tggtttagag 660

gaggttactc ctagtgagga aaatggcgga cagagctcca gtcttgactt ctacggttcc 720

tcctttatga cggatgaaac aggagctatt ctagaacgag ctgaaagaca agaagaagct 780

gttctgttag ctacttatga cctagacaag ggagcaagtg aacgcctaaa ctggggcttg 840

tttcgagata gaagaccaga aatgtataga caaattacag attag 885

<210> 498
<211> 363
<212> DNA
<213> Streptococcus pneumoniae

<400> 498
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atgaactctt actactatgc ataccgtgac cgtcgtcaga aaaaacgtga cttccgcaaa 180

ttgtggatta ctcgtatcaa tgcggcagct cgtatgaacg gactttcata ctcacaattg 240

atgcatggtt tgaaattggc tgagatcgaa gttaaccgta aaatgcttgc tgacttggct 300

gttaacgatg cagtagcttt cacagctctt gcagatgcag ctaaagcaaa acttggtaaa 360

taa 363

<210> 499
<211> 555
<212> DNA
<213> Streptococcus pneumoniae

<400> 499
gagcctatca tggagtttga agaaaaaacg cttagccgaa aagaaatcta tcaaggacca 60

atatttaaac tggtccaaga tcaggttgaa ttaccagaag gcaagggaac tgcccaacgg 120

gatttgattt tccacaatgg ggctgtctgt gttttagcag taacggatga acaaaaactt 180

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ccgcaggatg aggatgaaac cttggaagtc cttgaagtga gcttagaaga agcgaaagaa 480

ttaatccaat caggtcatat ctgtgatgcc aagacaatta tggctgttca gtattgggag 540

ttgcagaaaa aatag 555

<210> 500
<211> 585
<212> DNA
<213> Streptococcus pneumoniae

<400> 500
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caacagccaa aacaacaaac gactgtacaa caaattgctg ttggaaaaga tgctccagac 180

ttcacattgc aatccatgga tggcaaagaa gttaagttat ctgattttaa gggtaaaaag 240

gtttacttga agttttgggc ttcatggtgt ggtccatgca agaaaagtat gccagagttg 300

atggaactag cggcgaaacc agatcgtgat ttcgaaattc ttactgtcat tgcaccagga 360

attcaaggtg aaaaaactgt tgagcaattc ccacaatggt tccaggaaca aggatataag 420

gatatcccag ttctttatga taccaaagca accaccttcc aagcttatca aattcgaagc 480

attcctacag aatatttaat tgatagccaa ggaaagattg gaaagattca atttggtgct 540

atcagtaatg cggatgcaga agcagcattt aaagaaatga actag 585

<210> 501

<211> 1269
<212> DNA
<213> Streptococcus pneumoniae

<400> 501
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aatgctattg ccaaagaaga agaacgccaa caaaataata tcgagttaat tgcttcggaa 120

aacgtagttt ccaaggctgt tatggcagct caagggtcta tcttgacaaa taaatatgcc 180

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ggtcaaacct acaactttgt ttcttatagt gttgatccta aaacggaact cttagacttt 480

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gaagaaagtc gcaaagtggc tgaactcatc attaaaaccc ttaagaattc agaaaatgag 1200

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gaggactaa 1269

<210> 502
<211> 1035
<212> DNA
<213> Streptococcus pneumoniae

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gataaaatag ttttagatca tgctttcggt caaactatat tagataaaaa acctgaaaga 180
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<212> DNA
<213> Streptococcus pneumoniae

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ctagtgacta gcttatcaaa tgatgaaatg gtctatattt cacgctattt ctctatcttg 240
cctcttttga ttaatatttc agaggatgtg gatttagctt atgaaatcaa tcatcaaaat 300
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gctgacaatc catatctaaa agctagtctg gattaccgta tgccttactt taatattctc 2580

aactatattc agttggagtt gattaaacgc caacgtcgtg gagaattgtc cagtgatcaa 2640

gaacgattga ttcatatcac catcaacgga attgcgacag gattgcgtaa ttcaggttga 2700

<210> 504
<211> 372
<212> DNA
<213> Streptococcus pneumoniae

<400> 504
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tttgaaacta aggttggtaa ctatgaactg actcgccttt tggaaaaagt gccaaacagc 180

ggtgaaggct tccaactcaa aatcatcatt aacaaggaac ttacaggggc taaaatcaat 240

atcactgaca agtttggcct tcgtctagtt gatattttca aatcagaaga ccaccatatt 300

catcaggaaa aattctactt cctcatggat agcttggtag aacgtggtgt ctttacaaaa 360

tcggaaagat ag 372

<210> 505
<211> 1050
<212> DNA
<213> Streptococcus pneumoniae

<400> 505
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atttataaag tttacagagg acggtctata atgtcagata gaaaaaacat gaaactttc 120

gcactcaact ctaaccaaga gattgcacaa aaaattgccc aagctgttgg tgtcccactt 180

ggaaaactat catcacgtca attttcagac ggagaaatcc aagtaaatat cgaagaaagt 240

gtccgtggtt atgatgttta catcatccaa tcaacaagtt tccctgtcaa caaccaccta 300

atggaattgt taatcatggt cgatgcttgt gtgcgtgcaa gtgcccacag tatcaacgtt 360

gtccttccat attttggcta tgcacgtcaa gaccgcattg cttgtcctcg tgagccactt 420

acagcaaaac tagttgccaa tatgctggtt aaggctggag ttgatcgtat cctgactctt 480

gatttgcatg ccgttcaggt tcaaggtttc tttgatattc cagtggataa tcttttcact 540

gttcccctat tcgcaaaaca ttactgcgat aaaggattgc ttggttcaga tgttgttgtc 600

gttagcccta aaaattcagg tgtcaaacgt gcgcgtagcc tggctgaata tcttgatgct 660

cctatcgcca ttatcgacta ccctcaagac gatgcaactc gtaacgaagg ttatattatt 720

ggtgatgttg aaggtaagaa agctatcttg attgatgata ttttaaatac aggacgtacc 780

ttctctgaag cttctaaaat cgttgaacgt gaaggagcta cagaaattta tgctgtttct 840

agccacggtc tcttcgtcga gggagctgct gagcttcttg acaatactaa tattaaagaa 900

attcttgtga ctgattcagt agcaacaaaa gaaaaaactc ctaaaaatgt atgctacatc 960

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ccactctttg cctacaataa aaagaaataa 1050

<210> 506
<211> 1470
<212> DNA
<213> Streptococcus pneumoniae

<400> 506
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aatttagtaa atggaaaatg gaaatcatct gaacaagaaa ttacgattta ttcaccaatc 120

aatcaagaag aattgggtac agttccagcc atgactcaga ctgaagctga tgaggctatg 180

caagctgcgc gtgcagccct gccagcatgg cgagctttat cagcagttga acgtgcggct 240

tatttgcata aaacagcagc tattttagaa cgcgataagg aagaaattgg tactatcctt 300

gccaaagaag tagcaaaagg gattaaagca gcaattggag aagtagtgcg tacagcagac 360

ttgattcgtt atgctgctga ggaaggtctc cgtatcactg gacaagcaat ggaaggtggt 420

ggttttgagg caacaagtaa aaacaaactg gctgttgtcc gtcgtgaacc agttggtatc 480

gtgctagcga ttgctccctt taattatcca gttaatttat ctgcttctaa aattgcacct 540

gccttgattg cagggaatgt ggtcatgttt aagccaccaa cacaaggttc catttctgga 600

ctcttgttgg ctaaagcatt tgaagaagca gggattccgg caggtgtttt caacaccatt 660

acaggtcgtg gttcagaaat tggggattat atcattgagc acaaagaagt caacttcatc 720

aactttacag gttcaactcc tattggagaa cgtattggtc gtttagctgg tatgcgtcct 780

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catgctgcca agcaaattgt tgcgggagcc tttagctact caggacaacg ttgcacggcc 900

attaaacgtg tcattgttct cgaaagtgta gcagataaat tagctacttt gcttcaggaa 960

gaagtttcta aattaacagt tggtgatcca tttgacaatg ctgatattac acctgttatt 1020

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caggctctta caccaatcaa acgtgagggc aatcttctct ggccagtgct ttttgaccaa 1140

gttacaaaag atatgaaagt ggcatgggaa gagccatttg gtcctgtttt accaatcatt 1200

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ggtacagtcc acattaataa taaaacccag cgtggtccag ataatttccc attccttggt 1380

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<210> 507
<211> 993
<212> DNA
<213> Streptococcus pneumoniae

<400> 507
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gaaaatggta tcatctcagc tcttgcattt gaccaacgtg gtgctttgaa acgcctcatg 120

gttaaacacc aaacagaaga accaactgtg gcccaaatgg aagaacttaa agtcttggta 180

gcagatgaat tgactaaata tgcttcatct atgcttcttg accctgagta tggacttcca 240

gcaactaaag ctcttgatga aaaagctggt cttctccttg cttatgaaaa aacaggttat 300

gacacaacaa gcacaaaacg cttgccagac tgcttggatg tttggtctgc aaaacgtatt 360

aaagaagaag gtgcagatgc agttaaattc ttgctttact atgatgtaga tagctcagac 420

gaactcaatc aagaaaaaca agcctacatc gaacgcatcg gttctgagtg tgtggctgaa 480

gatatcccat tcttccttga aatccttgct tacgatgaaa aaattgcgga tgcaggttct 540

gtagaatacg ctaaagtaaa accacacaaa gttatcggcg ctatgaaagt cttttcagac 600

ccacgcttta acattgatgt tttgaaagtt gaagttcctg ttaacattaa atatgttgaa 660

ggcttcgctg aaggtgaagt agtttataca cgtgaagaag cagcagcctt cttcaaagcg 720

caagatgaag caacgaactt gccatacatc tacttgagtg ctggtgtatc agctaaactc 780

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ggccgtgcta catgggcagg atcagttgaa gcttacatca aagatggtga agcagcagct 900

cgcgaatgcg ttcgcacaac tggatttgaa aacattgacg aactcaacaa agttcttcaa 960

agaacagcaa cttcatggaa agaacgcgtg taa 993

<210> 508
<211> 546
<212> DNA
<213> Streptococcus pneumoniae

<400> 508
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gtaactgatg aaaaaatggc ggtttcagaa tttttgaaat caaaaggata tgaagtcatt 120

gactttggta cctatgacca tacacggact cactacccaa tctttggtaa aaaagtaggg 180

gaagctgtaa ctagcggtca agctgatctt ggagtatgta tctgtggtac tggtgttggt 240

atcaacaacg ctgtaaataa agttccaggt gttcgttctg ccttggttcg tgatatgaca 300

acagcccttt atgctaaaga acaattgaac gctaacgtta ttggttttgg tggtaaaatt 360

actggtgaat tgcttatgtg tgatatcatc gaagctttca tccatgctga atacaaacca 420

actgaagaaa acaaaaaatt gattgcgaaa attgaacatg ttgaaagtca caatgctcaa 480

caaacagacg caaacttctt tacagaattc cttgagaaat gggatcgtgg agaataccac 540

gactaa 546

<210> 509
<211> 441
<212> DNA
<213> Streptococcus pneumoniae

<400> 509

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gaagttgtga aagacttctt agaaaaagaa aacttccacc ttgtggatgt tacagctgaa 120

ggtcaagact ttgttgatgt gactctcgct gttgctgcag aagtaaacaa agaagaacaa 180

aaccttggta tcgtgattga tgcttatgga gctggtccat ttatagttgc aactaagatc 240

aaaggaatgg ttgctgcaga agtatctgac gaacgttcag cttatatgac tcgtggccac 300

aacaactcac gtatgatcac tatgggagca caacttgttg gtgatgaatt ggctaaaaat 360

atcgctaaag gatttgttaa tggtaaatac gacggtggtc gtcaccaaat ccgggttgac 420

atgttgaaca aaatgggcta a 441

<210> 510
<211> 1893
<212> DNA
<213> Streptococcus pneumoniae

<400> 510
cagggtatgg tcttgtcaaa atatcaaaaa caatttataa taaatagata ccctgaaagg 60

aagagaatca tgaacttaga agaattgaaa aaacgacagg agaagatccg taacttctct 120

attatcgccc atattgacca cggaaaatca actctagcag accgcatttt ggaaaaaaca 180

gagacggttt caagtcgtga aatgcaggcc cagcttttgg atagcatgga gctagagcgg 240

gaacgtggaa ttactattaa gttgaatgcc atcgagttga attacactgc aaaagatggg 300

gaaacttata ttttccactt gattgacaca ccagggcacg ttgactttac ctatgaagtt 360

tcacgttcgc tagctgcctg tgagggtgct attttggtgg tcgatgcggc tcaaggaatt 420

gaggctcaaa ctcttgccaa cgtttatctg gctttggata atgatttgga aatcatgcct 480

atcattaata aaattgacct gccggctgca gatccggagc gcgtgcgtac agagattgaa 540

gatgtgattg gtttggatgc cagtgaagca gttttggctt ctgccaaggc tggtattggg 600

attgaagaaa tcctcgagca aattgtagaa aaagtaccag caccaacggg tgatgtgacg 660

gcgccactta aggccttgat tttcgactct gtttacgatg cttaccgtgg ggttatcctc 720

caagtgcgtg tcatggacgg agtggtcaaa cctggtgata agattcagct catgagcaat 780

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cgtgtgggtg ataccgttac cttggcaacc aatcctgcgg cagaaccatt acatggttat 960

aagcagatga atcctatggt ctttgcgggt ctctacccaa tcgaatcaaa caagtacaat 1020

gacctgcgtg aagcgcttga aaaattgcaa ctgaatgatg ctagtcttca gtttgaacca 1080

gaaacatctc aggcacttgg atttggtttc cgttgtggat ttcttggact tctccatatg 1140

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aacgtacttg ctaaatgtta tggtggtgac gtttctcgta agcgtaaact ccttgaaaaa 1800

caaaaagctg gtaagaaacg catgaaatcc atcggatcag ttgaagttcc gcaagaagcc 1860

ttcctcagcg tcttgagtat ggatgaagaa taa 1893

<210> 511
<211> 1347
<212> DNA
<213> Streptococcus pneumoniae

<400> 511
gtggagatgg aaaagtattt atcggtaaca actttgacca agtatctgaa aatgaaattc 60

gataaagacc catacttgga acgggtctat ttaactggtc aagtttccaa ctttcgtaaa 120

cgacctactc accaatattt ctccctaaag gatgaccatg cagttattca agcgaccatc 180

tggtctggga tttatcagaa attagggttt gacctggaag aaggaatgaa gatcaatgtg 240

attgggcgtg tacaggtcta tgaaccaagt ggtagctact ccatcatcat tgaaaaagct 300

gagcctgatg gggttggggc gcttgcgatt cagtttgaac aacttaagaa aaaattgaca 360

gaagaaggcc tgtttcaaga acgcttcaag caagctctgc cccaattttc taagagaatt 420

ggtgtagtaa ccagccgtag tggagccgtt attcgagata ttatcacgac cgtcagcagg 480

cgattcccag gtgttgacat ccttctttat ccgaccaagg ttcaaggtga aggggctgcg 540

gaggaaattg ctagaaatat tgcgcgtgct aatcaacggg acgatttgga tttgctcatt 600

attggtcgtg gaggtggttc tattgaggat ctctgggcct ttaacgaaga aattgtggta 660

cgagctattt ttgaatctcg tttgccagtt atctctagtg tggggcatga gacggatgtg 720

accttggcag attttgtggc agatcgacgc gctgcaacgc caacagcggc ggctgaactg 780

gcaacacctg tgaccaagtt ggatgtatta gctcatttgc aaaatcagga aaaacggatg 840

gtaacggcag tccgaaatgt tctatctaag aaacaagagg ctttgaaaaa atgcagtcag 900

tctgttatct ttagacaacc tgagcgcttg tatgacggtt atttgcaacg cttggaccaa 960

ctgcaactgc gtttgaaaca aagtttgcga actcggattt ctgataacaa acaattagtt 1020

caagcaagaa ctcatcaatt agtacaatta tcacctgtta ccaaaatcca acgctatcaa 1080

gaccgtttag gacagttgga caagctctta ggtagccaaa tggcgttagt ttatgacgcc 1140

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gtggcgcgtg gttatgctat tgtcaaaaaa gaagagtccg ttgtagattc ggttgagagt 1260

ttgaagaaaa aagaccaagt aacgcttttg atgcgagatg gtcaagtaga attagaggtt 1320

aaagatgtca aaacaaaaga aatttga 1347

<210> 512
<211> 750
<212> DNA
<213> Streptococcus pneumoniae

<400> 512
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atcctagcag gatttctgat attactgtca ctggctttga tttttaatac tcaaattcga 120

aatattttca tagtctggaa taccaataag tatcaagtta gccaggtatc aaaagaaaaa 180

ttagaagaaa atcaggatac agaaggcaat tttgactttg attctgtcaa agctatctct 240

tcggaagctg ttctaacttc tcaatgggat gctcaaaaat taccagttat tgggggaatt 300

gcaattcctg aattggaaat gaatttgccg attttaaag gacttgataa tgttaatctc 360

ttctacggag ctggtacaat gaaacgcgag caagtaatgg gagaaggaaa ttatagtcta 420

gctagtcacc atatctttgg tgttgataat gctaataaaa tgttattttc tcctttagat 480

aatgctaaaa atggcatgaa gatttatcta accgataaaa ataaagttta tacttatgaa 540

atacgtgaag tcaaacgtgt gacaccggat cgtgttgatg aagttgatga tagagatggg 600

gtcaatgaaa tcacattagt aacctgtgaa gaccttgctg ctacagaacg tattattgtc 660

aaaggtgatt tgaaagaaac aaaagattat tcacaaacat ctaatgaaat cctaacagct 720

ttcaatcaac catataaaca attttattaa 750

<210> 513
<211> 1026
<212> DNA
<213> Streptococcus pneumoniae

<400> 513
ggaaaatccc ctaataaaat taaggagatg tttaaaacaa tgacttcaac taaacaacac 60

aaaaaagtta tccttgtcgg tgatggtgct gtaggttcat cttacgcttt tgcacttgtt 120

aaccaaggaa ttgcacaaga gcttggaatt atcgaaattc cacaattgca tgaaaaagct 180

gttggtgatg cgcttgacct tagtcacgcc cttgccttca cttcacctaa aaaaatctat 240

gcagctcaat actctgactg tgcagacgct gaccttgttg tgatcactgc aggtgcacct 300

caaaaaccag gtgaaactcg tcttgacctt gtaggtaaaa accttgctat caacaaatca 360

atcgtaactc aagttgttga atctggtttc aaaggtatct tccttgttgc tgctaaccca 420

gttgacgttt tgacttactc aacttggaaa ttctctggtt tccctaaaga acgcgttatc 480

ggttcaggta cttcacttga ctcagctcgt ttccgtcaag cacttgctga aaaattggat 540

gtggatgctc gttcagtgca cgcctacatc atgggtgaac acggtgactc tgagttcgct 600

gtttggtcac acgctaacat cgctggtgta aaccttgaag aattccttaa agacactcaa 660

aatgttcaag aagctgaatt gattgaattg ttcgaaggtg ttcgtgatgc agcctacaca 720

atcatcaaca aaaaaggtgc aacatactac ggtatcgcag tagcccttgc tcgtatcact 780

aaagcaatcc ttgacgatga aaacgcagta cttccacttt cagtattcca agaaggtcaa 840

tacggagttg agaatgtctt tatcggtcaa ccagctgttg ttggtgcaca tggtatcgtt 900

cgtccagtaa atatcccatt gaacgacgca gaaactcaaa aaatgcaagc atctgctaaa 960

gaattacaag ctatcattga cgaagcatgg aaaaacccag aattccaaga agcttctaaa 1020

aactaa 1026

<210> 514
<211> 588
<212> DNA

<213> Streptococcus pneumoniae

<400> 514
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acgggttcaa tcgcctctta taagtcggca gatttagtca gttctctaaa aaaacaaggc 120

catcaagtca ctgtcttaat gactcaggct gctacagagt ttatccaacc tttgacacta 180

caggtactct cacagaatcc tgtccacttg gatgtcatga aggaacccta tcctgatcag 240

gtcaatcata tcgaacttgg aaaaaaagca gatttattta tcgtggtacc tgcaactgct 300

aacactattg caaaactagc tcacggattt gcggacaaca tggtaaccag tacagctcta 360

gccctaccaa gtcatattcc caaactaata gctcctgcta tgaatacaaa aatgtatgac 420

catccagtaa ctcagaataa tctgaaaaca ttagaaacct acggctatca gctgattgct 480

cctaaggaat ccctactagc ttgtggagac cacggacgag gagctttagc tgacctcaca 540

attattttag aaagaataaa ggaaactatc gatgaaaaaa cgctctaa 588

<210> 515
<211> 924
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<213> Streptococcus pneumoniae

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gaacaactgg gtggaatgac caatcaaaac tatttggcca aaacaacaaa taagcaatac 180

attgttaaat tctttggtaa agggacagaa aagcttatca atcgacaaga tgaaaagtac 240

aatcttgaac tactaaagga tttaggctta gatgtaaaaa attatctttt tgatattgaa 300

gctggtatca aagtaaatga gtatatcgaa tctgcgatta cgcttgattc aacgtcaatc 360

aagaccaagt tcgacaaaat tactccaata ttacaaacta ttcatacgtc tgctaaggaa 420

ttaagaggag aatttgctcc ttttgaagaa atcaaaaaat acgaatcctt gattgaagaa 480

caaattcctt atgccaacta tgaatctgtt agaaatgcag tcttctcctt agagaaaaga 540

ctggctgact taggtgttga cagaaaatct tgtcatatcg atttggtgcc tgaaaacttt 600

atcgaatcac ctcaaggacg actttatttg attgactggg aatattcatc aatgaatgat 660

ccaatgtggg atttggctgc cctcttttta gagtctgaat tcacttccca agaggaagaa 720

actttcttat ctcactatga gagtgaccaa acaccggttt ctcatgaaaa gattgctatt 780

tataaaattt tacaagatac tatttggagt ctatggactg tctataagga agagcaaggt 840

gaagattttg gtgactatgg tgtgaatcgt taccaaagag ctattaaagg tttggcttct 900

tatggaggtt cagatgaaaa gtaa 924

<210> 516
<211> 813
<212> DNA
<213> Streptococcus pneumoniae

<400> 516
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ctgattgggg cggttcgaca tgagggcttt atcccttggg acgacgatat tgatctgtcc 180

atgcctagag aagactacca acgatttatt aacatttttc aaaaggaaaa aagcaagtat 240

aagctcctat ccttagaaac tgataagaac tactttaaca actttatcaa gataaccgac 300

agtacgacta aaattattga tactcgaaat acaaaaacct atgagtctgg tatctttatc 360

gatattttcc ctatagatcg ctttgatgat cctaaggtca ttgatacttg ttataaactg 420

gaaagcttca aactgctgtc tttcagtaaa cataaaaata ttgtctataa ggatagcctt 480

ttaaaagatt ggatacgaac agccttctgg ttactccttc gaccggtttc tcctcgttat 540

tttgcaaata aaatcgagaa agaaattcaa aaatatagtc gtgaaaatgg gcaatatatg 600

gcttttatcc cttcaaaatt taaggaaaag gaagtcttcc caagtggtac ctttgataaa 660

acaatcgatt taccctttga gaatttaagc cttcctgcac ctgaaaaatt tgatactatt 720

ttgacacaat tttatggaga ttatatgacc ctaccaccag aagaaaaacg cttctacagt 780

catgaatttc acgcttataa attggaggat tag 813

<210> 517
<211> 357
<212> DNA
<213> Streptococcus pneumoniae

<400> 517
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gaacgtatcc agatttttga aggtgttgtt atcgcacgta aaggtgctgg aatctcagaa 180

aactacacag ttcgtaaaat ctctaacggt gtaggtgttg agcgtatctt cccaatccac 240

actccacgtg ttgaaaaaat cgaagttgtt cgttacggta aagtacgtcg tgcgaaattg 300

tactacttgc gtgctcttca aggtaaagca gctcgtatca aagaaatccg tcgttaa 357

<210> 518
<211> 459
<212> DNA
<213> Streptococcus pneumoniae

<400> 518
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gaagaaattg cagatattgt agcagacaaa ttacgtgact tgggcttgga tgttgatgtt 120

gatgaatgta caactgttga cgcttcagac ttcttggaag cagacatcgc tatcgttgcg 180

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gcagatctca acttgaatgg caaaatctac ggagtggtcg gctcaggaga taccttctac 300

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aaaggttcag agtgtgttaa agttgatctt tctgccgagg aagaagatat tgaacgcttg 420

gaacaattcg cagaagaatt ggctgctaaa gtaggataa 459

<210> 519
<211> 438
<212> DNA
<213> Streptococcus pneumoniae

<400> 519
gctacacagc gtagcctagc tacgaaaaaa actattataa aatttaaaac ttatttggag 60

gaaataacaa tggcattgaa cattgaaaac attattgctg aaattaaaga agcttcaatc 120

cttgaattga acgaccttgt aaaagctatc gaagaagaat ttggtgtaac tgcagctgct 180

cctgtagctg ttgctgcagc tgatgcagct gatgctggtg ctgctaaaga ttcattcgac 240

gttgaattga catctgcagg cgacaaaaaa gttggcgtta tcaaagttgt acgtgaaatc 300

actggtcttg gtcttaaaga agctaaagaa cttgttgacg gtgcaccagc acttgttaaa 360

gaaggcgttg caactgcaga agctgaagaa atcaaagcta aattggaaga agctggagct 420

tcagttactc ttaaataa 438

<210> 520
<211> 627

<212> DNA
<213> Streptococcus pneumoniae

<400> 520
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ggtttgggcg cgtttttctt tttgaaaaat tccccaagca aaataattac ggaggtgaac 120
acactaatga gtgaagcaat tattgctaaa aaagcggaac tagttgacgt agtagctgaa 180
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gatacagttc ttcgtcgtga gcttcgtgga agcgaagttg agtataaagt tattaaaaac 300
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gcagaaagca aagaagacgc ggcttaa 627

<210> 521
<211> 1809
<212> DNA
<213> Streptococcus pneumoniae

<400> 521
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ttcctccttt tcctagcctt tctaggaact attgcccaag ttggcttatc aatttaccta 180
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gttagtcgtg taaccacgga catcgaacag ttggcagctg gcttgaccat gatttttaac 480
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cagttgattg aagaatcgct tagtcagcag actataatcc agtccttcaa tgctcaaaca 720

gaatttatcc aaagattgcg tgaggctcat gacaactact caggctattc tcagtcagcc 780

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gtgcttcaag aaacctggct cacacaaggg accattcatg ataatattgc ctttggcaat 1380

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gtcggccaag ctcagctctt gaccatagcc cgagtctttc tggctattcc aaagattctt 1560

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caggatgcgg atttaattct tgtcttagta gatggtgata ttgttgaata tggtaaccat 1740

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tctgaataa 1809

<210> 522
<211> 1053
<212> DNA
<213> Streptococcus pneumoniae

<400> 522
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tataaaaagc gaaaagcaaa tattttagct ctcatcgctt tatttgctct cattgctgta 120

ccatttacaa ttaaagcagt taggaataaa aacactgtca aagatacaac aagttattca 180

acttatctta tctataaaat cactcctcca aaagagtcgg acaaaacgat tttgaatcat 240

caaattggtg gttatagtga tttttatggg aaattgattg atggtaattt gaatggagct 300

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acagaaacaa ccttgaaaaa ttcaacgaat gactattggt ggaaaaaatt gaccgtctac 420

tatatgattg acgatgcagg ggttggtgtg aaaattttga catcaagtaa agatgccaat 480

aacttgttag agaaaaaaat tgatgggttg attgagaaat ttaaacatgc ctatgcaaat 540

gtgaaaattg aaaaactgga aaccatcaac tctaaagaat tgaacgcaaa tggtgaaaca 600

gcgcttggct taaatgtgaa aaatctgatt cttcgtttag ttgttattgg agtggtttgt 660

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gatttacagg atgtatcatc tcttttggaa agagatacag tccttcttgt tgaagagtac 960

ggagtgactc gttataagaa atttgagcaa agtcttcaaa ttctcagaaa cttaaatcgt 1020

tctatcctcg gtgtagcaac ctttaaatta taa 1053

<210> 523
<211> 1329
<212> DNA
<213> Streptococcus pneumoniae

<400> 523
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aaagaaaatc ccttaagtca tcatgagcag ttgcgttatg attatttgct aaaaaatatt 120

cactatctca atgagagaga aaaaaatgag tttgcctatt tgcaagaaaa gctaactctt 180

gctaggggaa atagtagctc tagcttggaa caagaaagag aagagcaggt tgacttacca 240

agctatgcga accggagtcg ctcacaatcc aaatcacaag cactctcttt ccctccaaaa 300

aagaaaagac ggaagctccg tcttaaacga atttttatgg tgatttttc acttttggtc 360

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cgaactgact ctattatggt attaaatgtc gggggctcag ataagaaaat gaagctagtc 600

agtttcatgc gtgataattt ggtctatata gatggttata gtcaagtgat taatggtaga 660

aaacagacag ataacaagtt aaacgtagcc tacgagttag gagaacaaga ggggcaaaaa 720

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gccttggttg atttccaggc ctttgccaca gcgattgaca cgcttttccc tgatggggtg 840

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cccactaaac ttttcactgg ttctgaagct cttggaaagg tttttgctat gacctcaacc 1140

aacgtaccct atactttcct cctaacaaac ggtttatctg ttttggatgg agcaaaaaat 1200

ggtattgaaa aattgacgat tccagaactg ggtgactggg tagatgccta tgatgtttat 1260

gggggcttgg gcctgctggt tgatcaaaac aaatatcaaa ccaagctcgc tcaaatgggc 1320

ttaagataa 1329

<210> 524
<211> 825
<212> DNA
<213> Streptococcus pneumoniae

<400> 524
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gaatccatta aggggattga tatgcaattt gaaagaaata aaattacagc tttgattggc 180

ccgtcgggat cggggaaatc tacctactta cgcagtctca atcgcatgaa tgatactatt 240

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atcaacgttt atgaaatgcg taaacacatt ggaatggttt ttcaacgtcc caatccattt 360

gctaagtcaa tttaccgtaa tattaccttt gcgcatgaac gtgctggagt taaggataag 420

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aagctacagt ccaccaatga ctatgtatct ggtcactttg gttag 825

<210> 525
<211> 1395
<212> DNA
<213> Streptococcus pneumoniae

<400> 525
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tgtatcaata ccatgttgga taattttgga aatgagaacg aaattgttgt atttgaccaa 120

aactctaaca tctctttcct aggatgtgga atggctcttt ggattggtga acaaattgac 180

ggtgctgaag gcttgttcta ttctgataaa gaaaaattgg aagctaaagg tgctaaagtt 240

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atcttgccac caatcgaagg tgttgaaatt gttaaaggaa accgcgaatt taaagcaact 420

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gatcacaaca tccgcttggc tctaggtcaa actgttaaag caatcgaagg tgacggtaaa 720

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acggctgaaa aataa 1395

<210> 526
<211> 1263
<212> DNA
<213> Streptococcus pneumoniae

<400> 526
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cgcttgcctt catcagttaa ccaacctaaa gactatgcgt ctatcgatgc tgctccagaa 240

gaacgcgaac gcggtatcac tatcaacact gcgcacgttg agtacgaaac tgaaaaacgt 300

cactacgctc acatcgacgc tccaggacac gcggactacg ttaaaaacat gatcactggt 360

gctgctcaaa tggacggagc tatccttgta gtagcttcaa ctgacggacc aatgccacaa 420

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aacaaagttg acttggttga cgacgaagaa ttgcttgaat tggttgaaat ggaaatccgt 540

gacctattgt cagaatacga cttcccaggt gacgatcttc cagttatcca aggttcagca 600

cttaaagctc ttgaaggtga ctctaaatac gaagacatcg ttatggaatt gatgaacaca 660

gttgatgagt atatcccaga accagaacgt gacactgaca aaccattgct tcttccagtc 720

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aaaccaggtt caatcaaccc acacactaaa ttcaaaggtg aagtctacat ccttactaaa 1020

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gataacgtga caatcgacgt tgagttgatt cacccaatcg ccgtagaaca aggtactaca 1200

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<211> 873
<212> DNA
<213> Streptococcus pneumoniae

<400> 527
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agtggctgga tcgtcatcgc tgttggttat ggtatggggg ttatgatccc agccttgatg 180

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gattcaaaat ggtggtattc ttgggtacca gtagtagcac ctatcgcagc agcaattgcg 840

gcagtagctg tattcaaatt cctttatctc taa 873

<210> 528
<211> 1416
<212> DNA
<213> Streptococcus pneumoniae

<400> 528
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tttgcagcag ggaaaaaact tcctgagatt aacaatgcac ttgtcgtcta caaaaatgac 120

gaaagaaaaa caaaaatcgt ccttgaagta gccttggagt taggagatgg tatggttcgt 180

actatcgcca tggaatcaac agatgggttg actcgtggaa tggaagtatt ggacacaggt 240

cgtccaatct ctgtaccagt aggtaaagaa actttgggac gtgtcttcaa cgttttggga 300

gataccattg acttggaagc tccttttaca gaagacgcag agcgtcagcc aattcataaa 360

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gttattgacc ttcttgcccc ttaccttaaa ggtggtaaag ttggactttt cggtggtgcc 480

ggagttggta aaactgtctt aatccaagaa ttgattcaca acattgccca agagcacggt 540

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acctctatcc aggctatcta tgtgccagcg gatgactata ctgacccagc gccagcaaca 960

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gaagagcact atgcagttgc tgctgaagta aaacgtgtcc ttcaacgtta ccatgaattg 1140

caagatatca ttgctatcct tggtatggat gagctttctg atgaagaaaa gaccttggtt 1200

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<210> 529
<211> 888
<212> DNA
<213> Streptococcus pneumoniae

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gaagctgctc gcaacttcca agtttacgct cagaaagtgc gtaaactttt gacagatatc 180

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gaaattctgg agcagttgtt gcctcagttt gcagaaagta tgatttacgg tgccattatc 720

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acacaagaaa ttacagaaat cgtagcaggt gctagtgcct tagaatag 888

<210> 530
<211> 1536
<212> DNA
<213> Streptococcus pneumoniae

<400> 530
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gtaacctata tcggggacgg tatcgcgcgt gctcacggcc ttgaaaatgt catgagtgga 180

gagttgttga attttgaaaa cggctcttat ggtatggctc aaaacttgga gtcaacagac 240

gttggtatta tcatcctagg tgactttaca gatatccgtg aaggcgatac aatccgccgt 300

acagggaaaa tcatggaagt ccctgtaggt gaaagtctga ttggtcgtgt tgtggatccg 360

cttggtcgtc cagttgacgg tcttggagaa atccacactg ataaaactcg tccagtagaa 420

gcaccagctc ctggtgttat gcaacgtaag tctgtttcag aaccattgca aactggtttg 480

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cgtcagacag ggaaaacaac cattgcgatt gatacaatct tgaaccaaaa agatcaagat 600

atgatctgta tctacgtcgc gattggacaa aaagaatcaa cagttcgtac gcaagtagaa 660

acacttcgtc agtacggtgc cttggactac acaatcgttg tgacagcctc tgcttcacaa 720

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gatgatattg ttcgtttcga ggaagagttc catgccttct ttgatgctca acatccagag 1440

attttggaaa ccattcgtga tacaaaagac ttgccagaag aagcagtctt ggatgctgcg 1500

attacagagt ttctcaatca atctagcttc caataa 1536

<210> 531
<211> 567
<212> DNA
<213> Streptococcus pneumoniae

<400> 531
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tcagacttga ctcaaatcaa gcaagttgtt gaaaaaacag gtctgccttc ttttttaaaa 180

caagtggcag tagacgagtc ggataaggaa aaaacaattg ctttttttcca agattctgtg 240

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acgattacgt ctgctcatcc tctaactgat gaacagaaga ctcgtttgct ccctttgatt 420

gagaaaaaaa tgtctctgaa agtaaggagt gtaaaagaac aaatcgatga aagtctcatt 480

ggtggttttg tcatttttgc caatcacaag acaattgatg tgagtattaa acaacaactt 540

aaagttgtta aagaaaattt gaaatag 567

<210> 532
<211> 498

<212> DNA
<213> Streptococcus pneumoniae

<400> 532
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attcttttgc tagtcttgat taaaaaattt gcatggtcta atattacagg cattttcgaa 120

gaaagagctg aaaaaattgc ttcagatatt gacagagctg aagaagcccg tcaaaaagca 180

gaagtattgg ctcaaaaacg cgaagatgaa ttggctggta gccgtaaaga agctaagaca 240

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aaactagaag caggacactt aaaagaaaaa gccaatcaag aaattgctca aaataaagta 360

gaagctttac agagtgttaa gggtgaggtc gcagatttga ccatcagctt agctggtaaa 420

atcatctcac aaaaccttga cagtcatgcc cataaagcac tcattgatca gtatatcgat 480

cagctaggag aagcttaa 498

<210> 533
<211> 1419
<212> DNA
<213> Streptococcus pneumoniae

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attcccactg tttttaaaca gttgcgtgaa aaaggaattt taacaggaat cgcctctgga 180

cgtggcattt ttggtgttgt tccagagatt cgtgatctca agcctgactt ttttgtaact 240

ttgaatgggg cttatatcga agataaaaaa ggtcaggtca tttatcagca tcagattgaa 300

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gttgggagtc atgatgccaa gttgtcgact cgcaccgata tgatgagtga agctatcaat 420

ccaatttatc ccgacttaga tgtagatccc gatttccatg aaaaagaaga tatctatcag 480

atgtggactt ttgaagataa gggagatgac ttgcacttgc ctgacagtct ctcagacaaa 540

cttcgcatgg ttcgttggca tcaacattcg tctgatattg tgccgatttc aggctccaaa 600

gcgacggggg tggaaaaggt tgtggaacac cttggcttga aaccagagaa ggtcatggtt 660

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gatggcattt ttgctgcctt agaagtattt ggtatggtag aaaaagaatt gcattttcca 840

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tcttacgctg tcttggatgc cattgctgct gttgagacag gagctatgga caagccagtt 1380

gaagatgttg taattgaaac tattgaaatc gaggactaa 1419

<210> 534
<211> 252
<212> DNA
<213> Streptococcus pneumoniae

<400> 534
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ttcgtttcag aacgtgggaa aatccttcct cgtcgtgtaa caggaacttc agctaaaaac 180

caacgtaaag taacaacagc tatcaaacgc gctcgcgtaa tggctttgat gcctttcgta 240

aacgaagatt aa 252

<210> 535
<211> 312
<212> DNA
<213> Streptococcus pneumoniae

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attgaagaag aagctaaaaa cgctttggta gcacgttttg actctatttt gactgacaac 120

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gatttccgtg aaggacttta ccacatcgtt aacgttgaag caaatgacga tgcagctctt 240

aaagagtttg accgtctttc aaaaatcaac gctgacattc ttcgtcacat gatcgtcaaa 300

attgacgcgt aa 312

<210> 536
<211> 1638
<212> DNA
<213> Streptococcus pneumoniae

<400> 536
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aattatgcca atgtagtcac ggttacggaa aaagacttta ctgaatttcc taagagtgac 420

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acctttaagc tacggtaa 1638

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<211> 2751
<212> DNA
<213> Streptococcus pneumoniae

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<211> 891
<212> DNA
<213> Streptococcus pneumoniae

<400> 538
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<211> 1260
<212> DNA
<213> Streptococcus pneumoniae

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<211> 1164
<212> DNA
<213> Streptococcus pneumoniae

<400> 540
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<213> Streptococcus pneumoniae

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tccgttctgc gtattcgatt tgtcaatctt ttaaaagatt ataagcaaac tttagaatac 840

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gatgcagaac aaagaaatgg taaaagttga 930

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<211> 345
<212> DNA
<213> Streptococcus pneumoniae

<400> 551

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aaaatcgtta aaatggacgt tgatgaaaat ccaaacacag ctcgtgcttt tggaatcatg 240

tctattccaa ctcttctctt caaaaaagac ggccaagttg tcaaacaagt tgcaggtgtt 300

cacacagcag aacaaatcaa ggccatcatt gctgaattga gctaa 345

<210> 552
<211> 624
<212> DNA
<213> Streptococcus pneumoniae

<400> 552
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gacttggaaa ttgttgaaat caacgtaaac gttgtcgaca tcaaaactaa agaacagcat 420

gaagcagact cagtaagcct tcaagatcgc gtatctgacg ttgctgaatc aacaggagaa 480

ttcacttcag aacaattcga aaaagctaaa tctggtcttg gatctggttt ctcaactgtt 540

caagaaaaag ttagcgaagg tgtagaagct gttaaaggtg cagcaaatgg tgtagtatct 600

cacgaaaaca ctcgtgtaaa ctaa 624

<210> 553
<211> 1764
<212> DNA
<213> Streptococcus pneumoniae

<400> 553
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gtcattaaaa gtgtcatacc cctcgtggct tcccacttta tcgaccagta tctcagcaat 180

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<210> 554

<211> 480
<212> DNA
<213> Streptococcus pneumoniae

<400> 554
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<210> 555
<211> 1014
<212> DNA
<213> Streptococcus pneumoniae

<400> 555
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gagtcatcag ctgaattaac cctggaagaa aaaaatagtc aatctcaccg tgccttagcc 960

gttaagaaac ttttggaggt atttccatca tggcaaagca aaccatcatt gtaa 1014

<210> 556
<211> 318
<212> DNA
<213> Streptococcus pneumoniae

<400> 556
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agaaaaatga tggatttact tttagcaatt gtattgattg tgctagcttt tctaggagga 120

gctctaggag gaatgtactt ggttcgtaag caaatcgaaa aagaatttgc tgacaaccca 180

cgtttgaatg ctgaagcagt tcgtactctt ttgagtgcaa atggtcaaaa accaagcgaa 240

gctaaggtac aacaagttta ccaccaaatc atccgccaac aaaaggcagc ccttgctaac 300

aataaaaaga aaaaataa 318

<210> 557
<211> 312
<212> DNA
<213> Streptococcus pneumoniae

<400> 557
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aaaatagaag aaaaagaaca aactgttgga ggctttgtcc ttgcaggctc agcccaagaa 120

aaaaccaaaa cagctcaagt tgtggctact ggacaaggtg ttcgtacctt gaacggtgac 180

ttggttgctc caagtgttaa aactggagat cgtgtcttag ttgaagccca cgcaggtctt 240

gatgtcaaag atggcgatga aaagtacatc atcgtaggcg aagctaacat tttggcaatc 300

attgaggaat ag 312

<210> 558
<211> 477
<212> DNA
<213> Streptococcus pneumoniae

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tttgccctat ttgtcaagac atgcgaaggt cttatctcag aggagattaa ccagtgggaa 420
agtatccagt caaaagaagt ggcagctagt gcagatgctc cagttaaaaa agagtag 477

<210> 559
<211> 1176
<212> DNA
<213> Streptococcus pneumoniae

<400> 559
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gaaaacaaaa aagatgagcc aaagaaagaa gaagcagtga atgaagaagt tccgcttgac 1140

ttaggcgatg aacttgaaat cgaaattgaa gaataa 1176

<210> 560
<211> 3720
<212> DNA
<213> Streptococcus pneumoniae

<400> 560
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tttaaaagta tgcaaatcac cctagcttct ccaagtaaag tccgttcatg gtcttatgga 120

gaagtcaaaa aacctgaaac aatcaattat cgtaccttga aaccagaacg tgaaggactc 180

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<210> 561
<211> 1011
<212> DNA
<213> Streptococcus pneumoniae

<400> 561
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cctatcttga gtaaggtcgg tgacggaatg caggacaacc tgtctggtgt ggaaaatcca 180

gtatcggtca aggttctcca aatccctgat gctacttatg aagtggtgca ctcacttgct 240

aaatggaaac gccacacctt ggctcgtttt ggctttggtg aaggagaggg tctctttgtc 300

cacatgaaag cccttcgtcc agatgaggat tccttggatg caacccactc tgtttatgtt 360

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gaaacagttg agaagattta taaggctatt cgcctgactg agctagctgt tgaagcccgc 480

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attggacaat ctcgtatggc catgttccta cttcgcaaga gacacatcgg agaagtgcaa 960

acaagtgttt ggcctcaaga agtccgcgat acttacgaaa atattttgta g 1011

<210> 562
<211> 837
<212> DNA
<213> Streptococcus pneumoniae

<400> 562
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tcatccatct cagaagatat cgtcattatc aaacgcgcct ttgaggaaat tgaaatcggt 180

catatccaga cagtgactgg ggctggcgga ggtgtcatct tcacaccgtc tatttcgagt 240

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ttgccaggtg gttatatcta tctgtctgat ttgcttagca caccagccat cttgaaaaat 360

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gcaactaagg gtgtgccact tgcaaatgca gttgccaatg tcctcaatgt ctcttttgtc 480

attgtgcgcc gtgacctgaa aattaccgaa ggttcaactg ttagcgtcaa ctatgtttca 540

ggttcaagtg gtgaccgtat cgagaaaatg ttcctttcaa aacgtagtct taaggcaggc 600

agccgtgtct tgattgtgga tgacttcttg aaaggtggcg gaacggtcaa tggtatgatt 660

agtctcttgc gcgagttcga ctcagaactg gcaggtgtag cggtctttgc ggacaatgcc 720

caagaagaac gtgaaaagca gtttgactac aagtcactct tgaaggtaac caatattgat 780

gtcaagaacc aagccatcga tgttgaggtt ggcaatatct ttgacgaaga taaataa 837

<210> 563
<211> 1224
<212> DNA
<213> Streptococcus pneumoniae

<400> 563
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ctgaatacag gaaatccagc agaatttggc tttacagcgc cagacgaggt cattcatgac 180

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atttaccttg gaaatggtgt cagtgagttg attgtcatgt ccatgcaggg gcttttggac 360

aatggggatg aggtcttagt gccaatgcca gactatcctc tatggacggc ggctgtcagc 420

ctagctggag gaaatgccgt tcactatatc tgtgatgaag ctgtggaatg gtacccagat 480

attgacgata tcaagtcaaa aatcacttcc aataccaagg caattgtcct tatcaatcca 540

aataacccaa ctggagccct ttatcctaag gaactcttgc tggagattat tgagattgcc 600

cgtcaaaacg atttgattat ctttgcggat gaaatctatg accgcatggt aatggacgga 660

catgtgcata cgcctgtggc gagcttggca ccagatgtct tctgtgtcag catgaatggt 720

ctgtcaaaat cccaccgcat agcaggtttc cgtgtgggtt ggatggtctt gtctggccct 780

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caggaaaagg ttctcttggt tcatggtcga ggctttaact ggcaggaacc agaccacttc 1140

cgtatcgttt accttcctcg tgttgatgag ttagcccaaa tccaagaaaa gatgactcgt 1200

ttcttgaaac agtatcgtag atag 1224

<210> 564
<211> 528
<212> DNA
<213> Streptococcus pneumoniae

<400> 564
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tcaggaggtt tcattatggc acaacgttac caaaatatca tggtcgcaat cgatggttct 120

aaggaagcgg acttggcttt tgtcaaggga gttcattctg ctctacgaaa cgacgctaaa 180

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gctaaagatg ctggggtagc agatgttcat atcgtcattg aaatgggaaa tccaaagacc 360

ctgctagcac gtactattcc agatgccgag gaagtggacc tcatcctcgt tggcgcaact 420

ggtctcaacg cctttgaacg cctcttggtc ggctcttcat ctgaatacat actccgccat 480

gctaaggtcg atttgctggt tgtgagagaa caagaaaaaa ccttataa 528

<210> 565
<211> 1113
<212> DNA
<213> Streptococcus pneumoniae

<400> 565
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gtaaccattt atgatgtcgc tcgtgaagca ggtgtttcca tggcgacggt cagccgtgtg 180

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ttgaaaaaag caggaatcac ttatagtgag ggtttggtat ttgaatctaa atatagctat 780

gatgatggtt acgccttagc agagcgtttg atttcatcaa atgcaactgc agcagttgtg 840

acaggtgatg agttggcagc aggagtcttg aacggtttgg ctgataaggg tgtttctgtg 900

ccagaagatt ttgaaattat tactagtgat gattcacaaa tctcacgctt tacccgtcca 960

aacttgacaa cgattgccca acctctttat gaccttggtg ccattagtat gcgtatgttg 1020

accaagatta tgcataagga agagttggaa gaacgtgaag ttctcttacc tcatggtttg 1080

acagaacgta gctcaacacg aaaacgtaaa tag 1113

<210> 566
<211> 591
<212> DNA
<213> Streptococcus pneumoniae

<400> 566
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gaaaatctat tacaacgtgc acaaacctac aatatgttgg ataatattct acgcgttgaa 180

attccaacac aaacagtgca agttgaaaaa aatggaaaga gaaaagaagt agaagaaaat 240

cgctttccag gttatgttct tgtagaaatg gtcatgacag atgaagcttg gtttgttgtt 300

cgaaacacac caaatgttac aggatttgtc ggatcacacg ggaacagatc aaaaccaact 360

ccattattgg aacaagaaat tcgcgacatt ttggtatcta tgggacaaac tgttcaagaa 420

tttgatttcg atgttgagat tggtcaaact gtacgtatta ttgatggtgc ttttgcagac 480

tacactggta agattacaga aattgataat aacaaagtga aaatgattat ctctatgttt 540

ggtaatgaca cagttgcaga agtaaatcta aaccaaatcg cagaattata a 591

<210> 567
<211> 2205
<212> DNA
<213> Streptococcus pneumoniae

<400> 567
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acaagtgaac tagaggactc tgattctact atcttacgtc gctctcgtag tgatcgaaaa 120

aaattagccc aagtaggtcc gattcgaaaa ttctggcgtc gttatcatct aacaaagatt 180

atccttatac taggtttgag tgcaggcttg ctagttggaa tctatttgtt tgctgtagcc 240

aagtcgacca atgtcaatga tttgcaaaat gccttgaaaa ctcggactct tatttttgac 300

cgtgaagaaa aagaggctgg tgccttgtct ggtcaaaagg gaacctatgt tgagctgact 360

gacatcagta aaaacttgca gaatgctgtt attgcgacag aagaccgttc tttctataaa 420

aatgacggga ttaactatgg ccgttttttc ttggctattg tcactgctgg acgttcaggt 480

ggtggctcta ccattaccca acagctggct aaaaacgcct atttatcgca ggatcaaact 540

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<210> 568
<211> 1221
<212> DNA
<213> Streptococcus pneumoniae

<400> 568
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gccttcaagg aattgttgcc agacattacc agtgtagttg tttttgatac ttccttccac 480

acaagtatgc cagagaaagc ttatcgctac cctctaccaa caaaatatta cacagaaaac 540

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aaactcttgg gacgtccatt agaagacttg aagttaatta cctgtcatat tggtaacgga 660

ggctcaatta cagctgtgaa agccggcaaa tctgtagaca cttctatggg gttcactcct 720

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ttaatgcaat atacagagga ttttaacaca ccagaagata tcagtcgtgt tcttaaccgt 840

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aaacatatcg gtcagtacct tgcagtgcta aatggagcag atgccattgt tttcacagca 1020

ggtgtcggtg aaaatgcaga gagtttccgt cgtgatgtaa tctcagggat ttcgtggttt 1080

ggttgtgatg ttgatgatga aaagaatgtc tttggcgtta caggagacat ctcaacagag 1140

gcagctaaaa tccgtgtctt ggttattcca acagatgaag aattagtcat tgcccgtgac 1200

gttgaacgct tgaaaaaata a 1221

<210> 569
<211> 1098
<212> DNA
<213> Streptococcus pneumoniae

<400> 569

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gctattgtgc gtattgtaaa aaccactatt tgtggaacag acctccatat tatcaaaggg 180

gatgttccta cttgccaaag tggtaccatt cttggccacg aagggattgg gattgttgaa 240

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tgtgcctgtg gtaaatgcta ctactgtaaa aaaggaattt atgctcactg tgaagacgaa 360

gggggctgga ttttcggtca cttgattgat ggtatgcagg ctgaatatct acgtgtccct 420

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cctgcaacat ttgatttctg tcaaaagatt atcggtgtag acggaacggt tgccaactgt 840

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cataagattg aaccggaaaa attggtaact cactatttca aactcagtga aattgaaaaa 1020

gcctacgaag tcttcagtaa ggcagcagac caccatgcca ttaaggtcat tatcgaaaac 1080

gatatctcag aagcctaa 1098

<210> 570
<211> 1704
<212> DNA
<213> Streptococcus pneumoniae

<400> 570
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ctgatgacag gcttgatggt tgctagttca cttctgcaac cgcgttatct gcaggaagtc 120

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ggtgtggccg tagtcggtct agttgctggt ggactcaatg ttgtcctcgc agcctatatt 240

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gaaatctatg aaacacagaa atga 1704

<210> 571
<211> 1050
<212> DNA
<213> Streptococcus pneumoniae

<400> 571

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cgtatttggg gaaatcttcc cgagcaaatc aatgaaatta atacacacca tactaataag 180

cactacttta aagatgtcgt tctagacgaa aatatcattg cctacaccga cttagcagaa 240

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gcccagcaag ttgcacaaac cttggaccat aaggttatca tcatgcacgc atcaaaggga 360

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gacctaactt taataactgc tgcttctaaa gatttacaaa cagctcaata cgttcagaag 540

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gaatccctag ctgatataga agctaatatg ggcatggtaa tcgaaggaat ttcaacgact 900

cgagcagcct atgaactagc ccaagaactt ggagtctata tgcccattac acaggctatt 960

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gaatttaaag cagaaaatga gtggtcttaa 1050

<210> 572
<211> 1284
<212> DNA
<213> Streptococcus pneumoniae

<400> 572
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ggttcatctg aagtcaaaga actcactgta tatgtagacg agggatataa gagctatatt 180

gaagaggttg ctaaagctta tgaaaaagaa gctggagtaa aagtcactct taaaactggt 240

gatgctctag gaggtcttga taaactttct cttgacaacc aatctggtaa tgtccctgat 300

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gtgaaattga gcgatggtgc taaaacagac gacacaacta aatctcttgt aacagctgct 420

aatggtaaag tttacggtgc tcctgccgtt atcgagtcac ttgttatgta ctacaacaaa 480

gacttggtga aagatgctcc aaaaacattt gctgacttgg aaaaccttgc taaagatagc 540

aaatacgcat tcgctggtga agatggtaaa actactgcct tcctagctga ctggacaaac 600

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atcaaacaaa aatttggtga ataa 1284

<210> 573
<211> 1023
<212> DNA
<213> Streptococcus pneumoniae

<400> 573
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aatgaagggg aattggtaga acttgacgaa gaacgaaaag ctgccatggt ttcaaatctc 960

cttgtcgttc tttgtggcaa tcatgatgca caaccaattg tcaacacagg aagcctttac 1020

taa 1023

<210> 574
<211> 1041
<212> DNA
<213> Streptococcus pneumoniae

<400> 574
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gcagaaaaag actttacccg tgcagagtta gaatacctta ttggtctttc agctcacttg 120

aaagatttga aaaaacgcaa tattcaacac cactaccttg ctggcaagaa tatcgctctc 180

ctatttgaaa aaacatctac tcgtactcgt gcagccttta caactgcggc tatcgacctt 240

ggtgctcacc cagaatacct cggagcaaat gatattcagt tgggtaaaaa agaatctact 300

gaagatactg ctaaagtatt gggacgtatg tttgacggga ttgaattccg cggattcagc 360

caacgtatgg ttgaagaatt ggcagaattc tcaggcgttc cagtatggaa cggtctaact 420

gacgaatggc acccaactca aatgctcgct gactacttga ctgttcaaga aaacttcggt 480

cgcttggaag gcttgacatt ggtatactgt ggtgatggac gtaacaacgt tgccaacagc 540

ttgctcgtaa caggtgctat ccttggtgtc aatgttcaca tcttctcacc aaaagaactc 600

ttcccagaaa aagaaatcgt tgaattggca gaaggatttg ctaaagaaag tggcgcacat 660

gttctcatca ctgaagatgc tgatgaagca gttaaagatg cagacgttct ttacacagac 720

gtttgggtat caatgggtga agaagacaaa ttcgcagaac gtgtagctct tcttaaacct 780

taccaagtca atatggactt agttaaaaaa gcaggcaatg aaaacttgat cttcctacac 840

tgcttgccag cattccacga tactcacact gtttatggta aagacgttgc tgaaaaattt 900

ggtgtagaag aaatggaagt aacagacgaa gtcttccgca gcaagtacgc tcgccacttc 960

gatcaagcag aaaaccgtat gcacactatc aaagctgtta tggctgctac acttggtaac 1020

ctttatattc ctaaagtata a 1041

<210> 575
<211> 924
<212> DNA
<213> Streptococcus pneumoniae

<400> 575
aaaaatactt gtggaggttc cattatggca atatttttca tgatttttct gattgtttgt 60

gtgctcctat tggtgatagt cacactgagt acagtttatg tggttcgtca gcagtcggtg 120

gcgattattg aacgctttgg gaaataccaa aaggttgcta atagcggtat tcatattcgc 180

ttgccttttg ggattgactc gattgcagca cggattcagt tgcgcttgtt gcaaagtgat 240

attgtggttg agactaagac caaggacaat gtgttcgtta tgatgaatgt agcgactcag 300

taccgtgtca acgagcagag cgtgacagat gcttactata aactcatacg tccagaatct 360

cagattaaat cttatatcga agatgctctt cgctcttctg ttccaaaatt aaccttggat 420

gaattgtttg agaaaaaaga tgagattgcc cttgaagttc aacaccaagt agcagaagaa 480

atgaccactt acggctacat tatcgtgaaa accttgatta ccaaggtcga accagatgca 540

gaagttaagc aatccatgaa tgaaatcaat gcggcgcaac gtaagcgggt cgcagcacaa 600

gaattggcgg aagctgacaa gattaaaatt gtcactgcag ctgaagcaga agcagaaaaa 660

gaccgccttc atggtgtggg gattgcccaa caacgtaagg cgattgtgga tggattggca 720

gagtctatca ccgaactcaa ggaagccaat gttggcatga cagaagaaca aatcatgtct 780

atcctcttga ccaaccagta tttggatacc ttgaatacct ttgcctctaa aggaaatcaa 840

actatctttt taccaaatac tccaaatggt gtggatgata tccgaacaca aatcttgtca 900

gcccttcgcg ctgagaagaa ataa 924

<210> 576
<211> 558
<212> DNA
<213> Streptococcus pneumoniae

<400> 576
agattatcct ttaccagcgc cctttttctt ttaaaaatga gaaaatttcg gtataatagt 60

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gatcatattg aggcctacat caaggcgatt ttagatcaat ctggtatcgt ggagttgcaa 180

cggagtcagt tggcagatac ctttcaggtt gttcctagtc agattaacta cgtgatcaag 240

acacgcttta cggaaagtag aggctacttg gttgaaagta agcgtggtgg cggaggctac 300

attcgtatag gacggattga gttttctagt catcatgaaa tgctccggga gctgctttac 360

tcgattggtg agcgagtcag tcaagaaatt tatgaggata ttctccagct tttggttgag 420

caggaattga tgaccaagca ggagatgaat ttgctagaat cagtagcttt ggatcgcgtt 480

ttaggagaag aagctccagt tgttcgagca aacatgctac gtcagatcat acaagaggta 540

gatagaaaag ggaagtaa 558

<210> 577
<211> 477
<212> DNA
<213> Streptococcus pneumoniae

<400> 577
aatgaaggaa aaggagaaag aagaatgaaa gtaatctttt tagcagatgt taaaggaaaa 60

ggtaaaaaag gcgaaattaa ggaagtacca acagggtatg cgcaaaactt tcttatcaaa 120

aagaatctag ccaaagaagc gactgctcaa gctgtaggtg aacttcgtgg taaacaaaaa 180

tcggaagaaa aagctcacgc tgagatgatt gcagaaggaa aagcaattaa agcacaactt 240

gaagcagaag aaactgttgt agaatttgtt gaaaaagttg gtccagatgg tcgtaccttt 300

ggttctatta ccaataagaa gattgcagaa gaattgcaaa agcaatttgg aattaagatt 360

gataaacgtc atattcaagt acaagctccg attcgagcgg ttggtttgat tgatgtgcca 420

gtgaaaatct atcaagatat cacaagtgta atcaatcttc gtgtgaaaga aggataa 477

<210> 578
<211> 564
<212> DNA
<213> Streptococcus pneumoniae

<400> 578
aaagaaggta ctcatatgat taaatatagt atccgtggtg aaaacctaga agtaacagaa 60

gcaattcgtg attatgtagt ttctaaactc gaaaagatcg aaaagtactt ccaaccagaa 120

caagagttgg atgcccgaat taacttaaaa gtttatcgtg aaaaaacggc taaagtggaa 180

gtaacgattc cgcttggatc tattactctc cgcgcagaag atgtatctca agatatgtat 240

ggttcaattg accttgtaac tgataaaatt gaacgtcaga ttcgtaaaaa taaaacaaaa 300

atcgagcgta aaaataaaaa taaggtagca actggtcaat tatttacaga tgctttggtg 360

gaagattcaa atattgtcca gtctaaagtt gttcgttcaa aacaaattga tttaaaacca 420

atggatttgg aagaagcaat tctacaaatg gatttattgg ggcatgattt ctttatctat 480

gtggatgttg aagatcagac aaccaatgtg atttatcgtc gtgaggatgg cgaaattggt 540

ttgttagagg ttaaagaatc ttaa 564

<210> 579
<211> 1080
<212> DNA
<213> Streptococcus pneumoniae

<400> 579
cccggctctc ctattttcaa aaaatatagg agaattaaaa tggcagaaat tacagctaaa 60

cttgtaaaag agttgcgtga aaaatctggt gccggtgtta tggacgctaa aaaagcgctt 120

gtagaaacag acggtgacat cgaaaaagcg attgaattgc ttcgtgaaaa aggtatggct 180

aaggcagcta agaaagctga ccgtgttgct gcagaaggtt tgactggtgt ttatgttaac 240

ggtaatgttg cagcagttat tgaagtaaac gctgaaactg acttcgttgc aaaaaacgct 300

caattcgttg aattggtaaa tactacagct aaagtcattg ctgaaggaaa acctgctaac 360

aacgaagaag ctcttgcttt gataatgcct tcaggtgaaa ctcttgaagc tgcatacgta 420

tctgcaacag caactatcgg agagaaaatc tcattccgtc gctttgcatt gattgaaaaa 480

acagacgcac aacactttgg agcataccaa cataacggtg gacgtatcgg tgttatttca 540

gttgttgaag gtggagacga agcacttgct aaacaattgt caatgcacat cgcagcgatg 600

aaaccaacag ttctttctta caaagaattg gatgagcaat tcgttaaaga tgagttggca 660

caattgaatc acgttatcga ccaagacaac gaaagccgtg caatggttaa taaaccagct 720

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acacttcttg cacaagttta catcatggat gacagcaaga cagttgaagc ataccttgaa 960

tcagttaacg cttcggtagt tgagtttgct cgctttgaag ttggtgaagg tatcgagaaa 1020

gctgcaaacg acttcgaagc tgaagttgca gctacaatgg cagcagcctt gaataactaa 1080

<210> 580
<211> 873
<212> DNA
<213> Streptococcus pneumoniae

<400> 580
tactcattct tgatgaattg tgaagcagtt gcccttgggt cgttttgcga gttgaagtca 60

agaagaggaa aaaaacaaaa aggagaaata ctcatggcag taatttcaat gaaacaactt 120

cttgaggctg gtgtacactt tggtcaccaa actcgtcgct ggaatcctaa gatggctaag 180

tacatcttta ctgaacgtaa cggaatccac gttatcgact tgcaacaaac tgtaaaatac 240

gctgaccaag catacgactt catgcgtgat gcagcagcta acgatgcagt tgtattgttc 300

gttggtacta agaaacaagc agctgatgca gttgctgaag aagcagtacg ttcaggtcaa 360

tacttcatca accaccgttg gttgggtgga actcttacaa actggggaac aatccaaaaa 420

cgtatcgctc gtttgaaaga aattaaacgt atggaagaag atggaacttt cgaagttctt 480

cctaagaaag aagttgcact tcttaacaaa caacgtgcgc gtcttgaaaa attcttgggc 540

ggtatcgaag atatgcctcg tatcccagat gtgatgtacg tagttgaccc acataaagag 600

caaatcgctg ttaaagaagc taaaaaattg ggaatcccag ttgtagcgat ggttgacacc 660

aatactgatc cagatgatat cgatgtaatc atcccagcta acgatgacgc tatccgtgct 720

gttaaattga tcacagctaa attggctgac gctattatcg aaggacgtca aggtgaggat 780

gcagtagcag ttgaagcaga atttgcagct ttagaaactc aagcagattc aattgaagaa 840

atcgttgaag ttgtagaagg cgacaacgct taa 873

<210> 581
<211> 834
<212> DNA
<213> Streptococcus pneumoniae

<400> 581
tataaaggta gggatatgaa ccgttttaaa aaatcaaaat atgtcattat tgtttttgtc 60

actgttctgc ttgtgtcagc tctcttagcg acgacttatt caagtacaat tgtgacaaaa 120

ttaggagatg gaatctcatt ggttgataga gttgtacaaa aaccttttca gtggtttgat 180

tctgtcaaat cagatttggc tcatttgaca cgaacatata atgaaaatga aagtttgaag 240

aaacagcttt accaattaga agttaaatca aatgaggtgg aaagtttaaa gacagaaaat 300

gaacaactgc gccaattgct tgatatgaag tctaaattgc aagccacaaa gactttagca 360

gcagatgtta ttatgcgttc tccggtatct tggaagcagg agttgacctt agatgcaggt 420

agatcaaaag gtgcttctga gaacatgtta gctattgcaa atggtggctt gattgggagt 480

gtttcaaaag tagaggagaa ctctactata gtcaaccttc tgacaaatac ggaaaatgct 540

gataagattt ctgttaaaat tcaacatggc tctactacaa tttatggaat tattattggc 600

tatgacaagg aaaatgacgt tcttaaaatt agccaattaa atagtaatag cgatattagt 660

gcgggagata aggtgactac tggtggatta ggaaacttta acgttgctga tattcctgtt 720

ggtgaagtgg ttgccacaac gcatagtaca gactatttga cacgagaagt aactgttaaa 780

ttgagtgcag atactcataa tgtagatgtg atagaattag tggggaattc ataa 834

<210> 582
<211> 846
<212> DNA
<213> Streptococcus pneumoniae

<400> 582
agggacattt ggttcgaaat gaaatcaata attgatgtaa aaaatctttc ttttcgctat 60

aaagaaaatc agaactacta cgatgtgaag gatattacgt ttcacgtgaa acgtggagaa 120

tggctttcga ttgtagggca taatggtagt ggtaaatcaa cgacggttcg attaattgat 180

ggcttactgg aagcagaatc cggagagatt gtaattgatg gccaacgttt gactgaggaa 240

aatgtttgga atatacgtcg tcaaatcggt atggtttttc aaaatccaga caatcaattt 300

gttggagcga ctgttgaaga tgatgttgct tttggtttgg aaaatcaggg actttctcgt 360

caagaaatga aaaagagagt ggaagaagct ctggctttag ttggcatgtt ggactttaaa 420

aagagagagc cagcgcgtct atcaggtggc caaaagcaac gtgtggccat tgcaggtgtt 480

gtagccctaa gaccagctat tttaatctta gatgaagcaa cgagtatgtt ggatcctgag 540

gggcgtagag aacttattgg gacagtaaaa ggaattcgaa aagactatga tatgacggtc 600

atttctatta cccatgattt ggaagaagtc gccatgagtg atcgcgtatt ggtcatgaaa 660

aaaggggaaa ttgaatcaac tagtagtcca agggagcttt tctctcgaaa tgatttagat 720

caaattggat tagacgatcc ttttgctaat caattaaaaa aatctttgag ccagaatggc 780

tatgatttac ctgaaaatta tttgacagaa agtgagctag aggataagct atgggaattg 840

ctctag 846

<210> 583
<211> 840
<212> DNA
<213> Streptococcus pneumoniae

<400> 583
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atcaatcagg gattgagttt agatgaattg cagaaaaaga cagaaatcca gttagatatg 120

ttggaagcaa tggaagcaga cgatttcgat caacttccaa gtccttttta cacgcgttct 180

ttcttgaaaa aatatgcatg ggctgttgag ttagatgacc aaattgtttt ggatgcttat 240

gattctggga gtatgattac ttatgaggaa gtagatgttg atgaagatga gttgacaggt 300

cgtagacgtt caagtaagaa aaagaagaaa aaaacatcat ttttaccttt attttatttt 360

atcctttttg ctttatcgat tttaattttt gtgacttatt atgtttggaa ctatattcaa 420

actcaaccag aggagccttc tctttctaat tacagtgtgg ttcaatcaac aagttcaact 480

agctctgttc cccactcctc aagtagtagt tcttctagta tagaatcagc tataagtgta 540

tcaggcgaag gaaatcatgt agaaatcgct tataagacaa gtaaggaaac agttaaattg 600

caattggcag tttcagatgt tacaagttgg gtcagtgttt cagaaagcga acttgagggc 660

ggtgtaacct tatcgccaaa gaagaaaagt gcagaagcaa cagttgcaac taaaagtcct 720

gtaacaatta cgttaggtgt tgtaaaaggt gttgatttga cagtagataa tcagactgtt 780

gatttatcga aattaacagc tcagactgga caaatcactg taacctttac taaaaattaa 840

<210> 584
<211> 1020
<212> DNA
<213> Streptococcus pneumoniae

<400> 584
atggaaaatc ttgtgaaaag cacaagttat acatatatac cggaggaaat catgtctttt 60

tctgatttaa agctgtttgc cctttcttct aataaagaat tggcagaacg tgtggcgcag 120

gagattggga tagagttggg gaaatcaagt gttcgccaat tttcagatgg agagattcag 180

gtcaacattg aagaatcaat ccgtgggaaa cacgtcttta tcttacaatc aactagttcg 240

cctgtaaatg acaatctgct tgaaattttg attatggtag atgctttgaa gcgtgcgagt 300

gcagaatctg tcaatgttgt catgccttac tatgggtatg cacgtcagga tagaaaggcg 360

agagcgcgtg agccaatcac ttcaaaactt gtcgcaaata tgcttgaagt agctggagtg 420

gatcgtttat tgaccatcga cttgcatgct gcgcaaattc aaggattctt tgatattcct 480

gtggatcatt tgatgggtgc tcctctgatt gcagattatt ttgagcgtcg tggtatggtt 540

ggttctgact atgtggttgt cagcccggac catggagggg tgactcgtgc tcgtaagttg 600

gcagaatttt tgaaaacatc tatcgctatt attgataaac gtcgtagcgt tgataagatg 660

aatactagtg aagttatgaa tatcatcggt aaggttgaag gcaagacttg tatcttgatt 720

gatgatatga ttgataccgc tggaacgatt tgtcatgcgg cagatgctct tgcggaagct 780

ggtgctgttg aagtctatgc aagctgtacg cacccagttc tttctggtcc tgctacggac 840

aatatccaaa aatcagctat taagaaattg gttgttttgg ataccatcta tctgccagaa 900

gagcgtttga ttgataagat tgagcagatt tcaatcgctc atctcctagg ggatgctatc 960

gtacgtattc atgaaaaacg accactttct ccacttttcg atattgagaa aaaaatttaa 1020

<210> 585
<211> 672
<212> DNA
<213> Streptococcus pneumoniae

<400> 585
gaggtatcta tggacttaac taagcgcttt aataaacagt tagataaaat tcaagtttcg 60

ttgattcgtc agtttgacca ggctatttcg gagattcctg ggtcttgcg tttgaccttg 120

ggggaacctg attttacaac gccagaccat gtcaaggagg cgggcaagcg agcgattgat 180

cagaaccaat cctactatac agggatgagt ggtctgctga ctctacgtca ggcagccagt 240

gactttgtta aggaaaagta ccaactggac tatgctcctg aaaatgaaat cttggttaca 300

attggggcga cagaggcttt atctgcgact ttgacggcta ttttggaaga gggagacaag 360

gtacttttgc cagctcctgc ttatccaggc tatgaaccga ttgttaactt agttggggca 420

gaaattgttg agattgatac gactgaaaat ggttttgtct tgactcctga gatgttggag 480

aaggccattt tggagcaggg tgataagctc aaggcggtta ttctcaacta tccagccaat 540

ccgacaggaa ttacctacag tcgagagcag ttagaggcct tggcagctgt tttacgcaag 600

tacgaaattt ttgttgtctg tgatgaggtt tactcagaat tgacctacac aggcgaagcc 660

atgtgtctct ag 672

<210> 586

<211> 1302
<212> DNA
<213> Streptococcus pneumoniae

<400> 586
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taccgtgctt ggcttgaggt ggaaatcctc tctgacgagg catgggctga gttgggggaa 120

atccctaagg aagatgtggc tttgattcgc aagaaggcgg actttgacat cgaccgtatt 180

ttggaaattg agcaggagac gcgccacgat gtggtggctt tcacgcgtgc ggtttctgag 240

actcttggtg aagagcgcaa gtgggttcac tatgggttaa cttctactga cgtggtggat 300

actgcttatg gttacctcta caagcaggcc aacgacatca tccgtcgtga ccttgaaaac 360

ttcactaata tcatcgctga caaggccaag gagcacaagt tcaccatcat gatggggcgt 420

actcatggtg tgcacgctga gccgacaacc tttggtctta aattagcaac ttggtacagc 480

gaaatgaaac gcaatatcga gcgcttcgag catgcggctg ctggtgtaga agctggtaag 540

atttctggtg cggttgggaa ctttgccaat atcccaccat ttgtagagga gtatgtctgc 600

gataaacttg gcatccgtgc ccaagaaatc tctacacaag tccttcctcg tgaccttcac 660

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attcgtggtc tacaaaaatc tgagcaacgc gaagtagaag agttctttgc taaagggcaa 780

aaagggtctt cagcaatgcc tcacaaacgc aacccaatcg gttctgaaaa tatgactggt 840

ctggcgcgtg tcattcgtgg tcacatgatt acggcttatg aaaacgtcgc tctctggcat 900

gaacgcgata tttctcactc atcagctgag cgtatcatca caccagatac gaccattttg 960

attgactaca tgctcaaccg ttttggaaat atcgtcaaga acttgacagt cttcccagaa 1020

aatatgatcc gaaacatgaa ctcgactttt ggtcttatct ttagccaacg ggctatgttg 1080

acattgattg aaaaaggcat gacccgtgag caagcctatg acttggtgca accaaaaaca 1140

gcctactctt gggacaacca agtagacttt aaaccacttc ttgaggcaga ttcagaagta 1200

acatcacgtc tcacacaaga agaaatcgat gaaatcttca acccagttta ttacaccaaa 1260

cgagtggatg atatctttga acgtcttgga ctaggtgatt aa 1302

<210> 587
<211> 918
<212> DNA
<213> Streptococcus pneumoniae

<400> 587
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caaatctgtg atgagttgac gatcgtttca tctgcaggtt cccctgtatt tgctggtttc 120

attactggtt taatcatggg agatgtgact actggtttac ttatcggtgg taacttgcaa 180

ctgttcgttc ttggggttgg taccttcggt ggtgcttctc gtatcgacgc aacttctggt 240

gcggttcttg cgacagcctt ctctgtttca caaggaattg atgcaccgct tgccattact 300

acaatcgctg taccagtagc agctctcttg acttacttcg acgttcttgg tcgtatgact 360

actaccttct tcgctcaccg tgtggatgct gcaatcgaac gctttgacta taaaggtatt 420

gaacgcaact acttgcttgg tgcgattccg tgggctctat ctcgtgccct tccagtcttc 480

tttgcccttg cttttggtgg tgcctttgta caatcagtag tagacttcgt tgaagcctac 540

aaatgggttg cagatggctt gacacttgca ggacgtatgc ttccaggtct tggatttgca 600

atcttgcttc gttaccttcc agttaaacgt aaccttcact accttgctat gggatttggt 660

ttgacagcta tgttgactgt tctttactca tatgtaacag gtcttggtgg cgctgttgct 720

ggtatcgtag gtactcttcc tgctgaagtt gctgaaaaaa ttggtttcgt gaacaacttc 780

aaaggtttgt ctatgattgg tatttctatc gtaggtattt tccttgcagt gcttcacttc 840

aaaaatagcc aaaaagtagc tgtagcagca ccttctacac catcagaaag tggggaaatc 900

gaagatgacg aattctaa 918

<210> 588
<211> 855
<212> DNA
<213> Streptococcus pneumoniae

<400> 588
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cttacaaaag aagattttaa tcaaatcaac aaacgtagct tgtttacttt ccaattaggt 120

tggaactacg aacgtatgca agcttctggt taccttttaca tgatcttgcc tcagttgcgt 180

aaaatgtatg gtgatggaac tcctgaattg aaagaaatga tgaaagttca tactcaattc 240

ttcaatactt caccattctt ccataccatt atcgctggtt ttgaccttgc catggaagaa 300

aaagatggtg taggttcaaa agacgccgtt aacggtatca agacaggttt gatgggacca 360

ttcgctcctc ttggggatac aatctttggt tcacttgtac ctgctatcat ggggtcagtc 420

gcagcaacta tggctatcgc tggccaacct tgggggatct tcctttggat tgcagttgca 480

gtagcgtatg acatcttccg ttggaaacag ttggaatttg cttacaaaga aggggttaac 540

cttatcaaca acatgcaaag taccttgaca gctttgattg acgctgcatc tgtacttggt 600

gtcttcatga tgggtgctct tgtagcaaca gtgattaact ttgaaatttc ttacaagttg 660

ccaatcggtg aaaagatgat tgatttccaa gacatcttga accaaatctt cccacgtttg 720

cttccagcaa tctttactgc ctttatcttc tggttgcttg gtaagaaagg tatgaactct 780

actaaagcta tcggtattat tatcgtactt gctttggctc tttctgccct tggtcacttt 840

gcacttggaa tgtaa 855

<210> 589
<211> 1182
<212> DNA
<213> Streptococcus pneumoniae

<400> 589
aaaaagagga actcaatgct acattataca aaagaagact tgctcgaatt gggtgcagaa 60

atcactacgc gtgaaatcta ccaacagcct gatgtatgga gagaagcttt tgaattttat 120

caagcaaaac gtgaagaaat tgcagccttc ctacaagaaa tcgctgataa acatgactat 180

attaaggtta tcttgacagg tgctgggact tctgcttatg tgggagatac cttgctacct 240

tattttaagg aagtctatga cgaacgcaaa tggaatttca atgctattgc gacaacagat 300

atcgttgcca atccagcaac ctatttgaaa aaagatgtgg caactgtcct tgtgtctttt 360

gctcgtagtg ggaattcgcc tgaaagtttg gcgactgttg atttggccaa atccttggtg 420

gatgagcttt atcaagtgac gattacttgt gcagcagatg gtaaattggc tcttcaagct 480

cacggtgatg atcgtaatct cttgctcttg caaccagctg tctctaatga tgctggattt 540

gccatgactt ctagctttac gtctatgatg ttgacaactc tcttggtctt tgatcctaca 600

gaatttgctg ttaagtctga acgttttgaa gttgtatcta gtcttgcccg taaagtttta 660

gacaaggcag aagatgtcaa agagctcgtt gatttagact ttaaccgtgt catctatcta 720

ggcgctggtc ctttctttgg acttgctcat gaagctcagc tcaagatttt ggaattaact 780

gctggtcaag ttgcgaccat gtatgaaagc ccagttggct tccgtcacgg tccaaaatct 840

cttatcaacg acaatacagt tgttttggtc tttggtacaa cgacagacta cactcgtaag 900

tacgacttgg acttggttcg tgaagttgct ggtgaccaga ttgctcgtcg tgttgtgctt 960

ttgagtgatc aagcttttgg tcttgaaaat gtcaaagaag tggcccttgg ttgtggcggt 1020

gtcttgaatg atatttaccg tgtcttccct tacatcgttt atgcccaact ctttgcttta 1080

ttgacttcac tcaaggtaga aaataaacca gatacaccgt ctcctacagg tacagtaaac 1140

cgtgtagtac aaggtgtcat aattcacgaa tatcaaaagt aa 1182

<210> 590
<211> 654
<212> DNA
<213> Streptococcus pneumoniae

<400> 590
ctatttccac cgaaatatta tttatatcag gaggacattc atatgtcacg ttatacagga 60

ccatcttgga aacaagctcg tcgtcttggc ctttcactta caggtacagg taaagaattg 120

gcacgtcgta actacgtacc aggacaacac ggaccaaaca accgttctaa attgtcagaa 180

tacggtttgc aattggctga aaaacaaaaa cttcgtttca cttacggtgt aggtgaaaaa 240

caattccgta acttgttcgt acaagctaca aaaatcaaag gcggaatcct aggtttcaac 300

tttatgcttc ttttggaacg tcgtttggat aacgttgttt accgtcttgg tctcgcgact 360

actcgtcgtc aagctcgtca attcgtaaac cacggtcaca tccttgttga cgggaaacgc 420

gttgatatcc catcataccg cgtaactcca ggtcaagtga tctcagttcg tgaaaaatca 480

ttgaaagttc cagcaatcct tgaagcagta gaagctactc ttggacgtcc agcattcgta 540

tcattcgacg ctgaaaaatt ggaaggttca ttgactcgct tgccagaacg cgacgaaatc 600

aacccagaaa tcaacgaagc acttgtcgtt gaattctaca acaaaatgtt gtaa 654

<210> 591
<211> 1032
<212> DNA
<213> Streptococcus pneumoniae

<400> 591
ataaaaaatt tagaaaattt aagaatagaa aagagaacaa atcttatggc aaaagatatt 60

cgtgtcttac tttactacct ttatactcca attgaaaatg cagagcaatt tgctgcagac 120

cacttggctt tctgtaaatc aatcggcctt aaaggccgta tcctagtcgc tgacgaggga 180

attaacggaa cagtttcagg tgactatgaa acaactcaaa aatacatgga ctacgttcac 240

agccttccag gaatggaaga actctggttc aagattgacg aagaaaatga acaagccttc 300

aagaagatgt ttgttcgcta caagaaagaa attgtccacc ttggtttgga agacaacgac 360

tttgacaatg acatcaaccc acttgaaaca acaggtgctt acttgtctcc aaaagagttc 420
aaagaagcgc ttcttgataa agataccgtt gtccttgaca cacgtaacga ttatgagtac 480
gacctaggac atttccgtgg agctattcgc ccagatattc gcaacttccg tgagttacca 540
caatgggtcc gtgataacaa ggaaaaattc atggacaagc gtgtcgtggt ttactgtaca 600
ggtggcgttc gctgtgagaa attctcaggc tggatggtcc gtgaaggcta caaagatgtc 660
ggccaattgc acggaggaat cgcaacttac ggtaaagacc cagaagttca aggtgagctt 720
tgggatggga aaatgtacgt ctttgacgag cgtattgccg ttgatgtcaa ccatgtcaac 780
ccaactatcg tagggaaaga ctggtttgat ggaacaccat gtgaacgtta tgtcaactgt 840
ggaaatccat tctgtaaccg tcgtatcttg acatcagaag aaaatgaaga caagtacctt 900
cgtggatgct cacacgagtg ccgtgttcac ccacgtaacc gctatgtttc aaaaaatgaa 960
ttgacacaag ctgaagttat cgagcgccta gccgctatcg gtgaaagctt ggatcaagca 1020
gctactgtat aa 1032

<210> 592
<211> 216
<212> PRT
<213> Streptococcus pneumoniae

<400> 592

Met Asn Ile Ala Val Ile Gly Leu Gly His Val Gly Leu Ala Tyr Ala
1 5 10 15

Leu Leu Phe Ala Ser Lys Tyr Lys Val Val Ala Tyr Asp Ile Asp Ser
20 25 30

Val Lys Ile Asn Asn Leu Lys Lys Gly Ile Leu Pro Ser Lys Asn Glu
35 40 45

Glu Leu Met Lys Phe Phe Cys Glu Asn Asn Leu Asn Ile Thr Phe Phe
50 55 60

Asp Thr Phe Ser Glu Ile Lys Asn Asn Ile Asp Tyr Tyr Ile Ile Ala
65 70 75 80

Leu Pro Thr Asp Tyr Asp Glu Lys Ile Gly Ser Phe Asn Thr Tyr Glu
85 90 95

Ile Glu Gln Thr Val Ser Lys Ile Leu Arg Val Lys Pro Asn Gly Lys
100 105 110

Ile Ile Leu Lys Ser Thr Val Pro Ile Gly Phe Ser Asn Lys Leu Lys
115 120 125

Arg Leu Phe Asp Thr Lys Asn Ile Ile Phe Val Pro Glu Phe Leu Arg
130 135 140

Glu Gly Cys Ser Ile Tyr Asp Asn Leu Tyr Pro Ser Arg Ile Val Val
145 150 155 160

Gly Asp Glu Thr Val Glu Gly Arg Lys Ile Ala Glu Leu Phe Leu Ser
165 170 175

Ile Ser Thr His Ser Thr Ala Asn Ile Lys Asn Val Met Leu Val Ser
180 185 190

Pro Thr Glu Ala Glu Ala Ile Lys Leu Phe Ser Asn Thr Phe Leu Ala
195 200 205

Leu Arg Val Ala Phe Leu Met Asn
210 215

<210> 593
<211> 234
<212> PRT
<213> Streptococcus pneumoniae

<400> 593

Met Val Leu Arg Gly Val Pro Met Ser Gln Ile Asp Leu Gln Lys Leu
1 5 10 15

Thr Lys Lys Asn Gln Glu Phe Val His Ile Ala Thr Gln Gln Phe Ile
20 25 30

Lys Asp Gly Lys Thr Asp Ala Glu Ile Gln Thr Ile Phe Glu Glu Val
35 40 45

Ile Pro Gln Ile Leu Glu Glu Gln Ser Lys Gly Thr Thr Ala Arg Ser
50 55 60

Leu Tyr Gly Ala Pro Thr His Trp Ala His Ser Phe Thr Val Lys Glu
65 70 75 80

Gln Tyr Glu Lys Glu His Pro Lys Glu Asn Asp Asp Pro Lys Leu Met
85 90 95

Ile Met Asp Ser Ala Leu Phe Ile Thr Ser Leu Phe Ala Leu Val Ser
100 105 110

Ala Leu Thr Thr Phe Phe Ala Ala Asp Gln Ala Phe Gly Tyr Gly Leu
115 120 125

Ile Thr Leu Leu Leu Val Gly Leu Val Gly Gly Phe Ala Phe Tyr Leu
130 135 140

Met Tyr Tyr Phe Val Tyr Gln Tyr Tyr Gly Pro Asp Met Asp Arg Ser
145 150 155 160

Gln Arg Pro Pro Phe Trp Lys Ser Val Leu Val Ile Leu Ala Ser Met
165 170 175

Phe Leu Trp Leu Leu Val Phe Phe Ala Thr Ser Phe Leu Pro Ala Ser
180 185 190

Leu Asn Pro Val Leu Asp Pro Leu Pro Leu Ala Ile Ile Gly Ala Ala
195 200 205

Leu Leu Ala Leu Arg Phe Tyr Leu Lys Lys Arg Leu Asn Ile Arg Ser
210 215 220

Ala Ser Ala Gly Pro Thr Arg Tyr Gln Glu
225 230

<210> 594
<211> 314
<212> PRT
<213> Streptococcus pneumoniae

<400> 594

Met Lys Gln Val Phe Leu Ser Thr Thr Thr Glu Phe Lys Glu Ile Asp
1 5 10 15

Thr Leu Glu Pro Gly Thr Trp Ile Asn Leu Val Asn Pro Thr Gln Asn
20 25 30

Glu Ser Leu Glu Ile Ala Asn Thr Phe Asp Ile Asp Ile Ala Asp Leu
35 40 45

Arg Ala Pro Leu Asp Ala Glu Glu Met Ser Arg Ile Thr Ile Glu Asp
50 55 60

Glu Tyr Thr Leu Ile Ile Val Asp Val Pro Val Thr Glu Glu Arg Asn
65 70 75 80

Asn Arg Thr Tyr Tyr Val Thr Ile Pro Leu Gly Ile Ile Ile Thr Glu
85 90 95

Glu Thr Ile Ile Thr Thr Cys Leu Glu Pro Leu Pro Val Leu Asp Val
100 105 110

Phe Ile Asn Arg Arg Leu Arg Asn Phe Tyr Thr Phe Met Arg Ser Arg
115 120 125

Phe Ile Phe Gln Ile Leu Tyr Arg Asn Ala Glu Leu Tyr Leu Thr Ala
130 135 140

Leu Arg Ser Ile Asp Arg Lys Ser Glu Gln Ile Glu Ser Gln Leu His
145 150 155 160

Gln Ser Thr Arg Asn Glu Glu Leu Ile Glu Leu Met Glu Leu Glu Lys
165 170 175

Thr Ile Val Tyr Phe Lys Ala Ser Leu Lys Thr Asn Glu Arg Val Ile
180 185 190

Lys Lys Leu Thr Ser Ser Thr Ser Asn Ile Lys Lys Tyr Leu Glu Asp
195 200 205

Glu Asp Leu Leu Glu Asp Thr Leu Ile Glu Thr Gln Gln Ala Ile Glu
210 215 220

Met Ala Asp Ile Tyr Gly Asn Val Leu His Ser Met Thr Glu Thr Phe
225 230 235 240

Ala Ser Ile Ile Ser Asn Asn Gln Asn Asn Ile Met Lys Thr Leu Ala
245 250 255

Leu Val Thr Ile Val Met Ser Ile Pro Thr Met Val Phe Ser Ala Tyr
260 265 270

Gly Met Asn Phe Lys Asp Asn Glu Ile Pro Leu Asn Gly Glu Pro Asn
275 280 285

Ala Phe Trp Leu Ile Val Phe Ile Ala Phe Ala Met Ser Val Ser Leu
290 295 300

Thr Leu Tyr Leu Ile His Lys Lys Trp Phe
305 310

<210> 595
<211> 102
<212> PRT
<213> Streptococcus pneumoniae

<400> 595

Met Ala Asn Lys Lys Ile Arg Ile Arg Leu Lys Ala Tyr Glu His Arg
1 5 10 15

Thr Leu Asp Thr Ala Ala Ala Lys Ile Val Glu Ser Ala Thr Arg Thr
20 25 30

Gly Ala Gln Val Ala Gly Pro Ile Pro Leu Pro Thr Glu Arg Ser Leu
35 40 45

Tyr Thr Ile Ile Arg Ala Thr His Lys Tyr Lys Asp Ser Arg Glu Gln
50 55 60

Phe Glu Met Arg Thr His Lys Arg Leu Ile Asp Ile Val Asn Pro Thr
65 70 75 80

Gln Lys Thr Val Asp Ala Leu Met Lys Leu Asp Leu Pro Ser Gly Val
85 90 95

Asn Val Glu Ile Lys Leu
100

<210> 596
<211> 208
<212> PRT
<213> Streptococcus pneumoniae

<400> 596

Met Thr Lys Gly Ile Leu Gly Lys Lys Val Gly Met Thr Gln Ile Phe
1   5   10   15

Thr Glu Ala Gly Glu Leu Ile Pro Val Thr Val Ile Glu Ala Thr Pro
            20   25   30

Asn Val Val Leu Gln Val Lys Thr Val Glu Thr Asp Gly Tyr Asn Ala
        35   40   45

Ile Gln Val Gly Phe Asp Asp Lys Arg Glu Val Leu Ser Asn Lys Pro
    50   55   60

Ala Lys Gly His Val Ala Lys Ala Asn Thr Ala Pro Lys Arg Phe Ile
65   70   75   80

Arg Glu Phe Lys Asn Val Glu Gly Leu Glu Val Gly Ala Glu Ile Thr
                85   90   95

Val Glu Thr Phe Ala Ala Gly Asp Val Val Asp Val Thr Gly Thr Ser
            100   105   110

Lys Gly Lys Gly Phe Gln Gly Val Ile Lys Arg His Gly Gln Ser Arg
        115   120   125

Gly Pro Met Ala His Gly Ser Arg Tyr His Arg Arg Pro Gly Ser Met
    130   135   140

Gly Pro Val Ala Pro Asn Arg Val Phe Lys Gly Lys Asn Leu Ala Gly
145   150   155   160

Arg Met Gly Gly Asp Arg Val Thr Ile Gln Asn Leu Glu Val Val Gln
                165   170   175

Val Val Pro Glu Lys Asn Val Ile Leu Ile Lys Gly Asn Val Pro Gly
            180   185   190

Ala Lys Lys Ser Leu Ile Thr Ile Lys Ser Ala Val Lys Ala Gly Lys
195 200 205

<210> 597
<211> 207
<212> PRT
<213> Streptococcus pneumoniae

<400> 597

Met Ala Asn Val Thr Leu Phe Asp Gln Thr Gly Lys Glu Ala Gly Gln
1 5 10 15

Val Val Leu Ser Asp Ala Val Phe Gly Ile Glu Pro Asn Glu Ser Val
20 25 30

Val Phe Asp Val Ile Ile Ser Gln Arg Ala Ser Leu Arg Gln Gly Thr
35 40 45

His Ala Val Lys Asn Arg Ser Ala Val Ser Gly Gly Gly Arg Lys Pro
50 55 60

Trp Arg Gln Lys Gly Thr Gly Arg Ala Arg Gln Gly Ser Ile Arg Ser
65 70 75 80

Pro Gln Trp Arg Gly Gly Gly Val Val Phe Gly Pro Thr Pro Arg Ser
85 90 95

Tyr Gly Tyr Lys Leu Pro Gln Lys Val Arg Arg Leu Ala Leu Lys Ser
100 105 110

Val Tyr Ser Glu Lys Val Ala Glu Asn Lys Phe Val Ala Val Asp Ala
115 120 125

Leu Ser Phe Thr Ala Pro Lys Thr Ala Glu Phe Ala Lys Val Leu Ala
130 135 140

Ala Leu Ser Ile Asp Ser Lys Val Leu Val Ile Leu Glu Glu Gly Asn
145 150 155 160

Glu Phe Ala Ala Leu Ser Ala Arg Asn Leu Pro Asn Val Lys Val Ala
165 170 175

Thr Ala Thr Thr Ala Ser Val Leu Asp Ile Ala Asn Ser Asp Lys Leu
180 185 190

Leu Val Thr Gln Ala Ala Ile Ser Lys Ile Glu Glu Val Leu Ala
195 200 205

<210> 598
<211> 98
<212> PRT
<213> Streptococcus pneumoniae

<400> 598

Met Asn Leu Tyr Asp Val Ile Lys Lys Pro Val Ile Thr Glu Ser Ser
1 5 10 15

Met Ala Gln Leu Glu Ala Gly Lys Tyr Val Phe Glu Val Asp Thr Arg
20 25 30

Ala His Lys Leu Leu Ile Lys Gln Ala Val Glu Ala Ala Phe Glu Gly
35 40 45

Val Lys Val Ala Asn Val Asn Thr Ile Asn Val Lys Pro Lys Ala Lys
50 55 60

Arg Val Gly Arg Tyr Thr Gly Phe Thr Asn Lys Thr Lys Lys Ala Ile
65 70 75 80

Ile Thr Leu Thr Ala Asp Ser Lys Ala Ile Glu Leu Phe Ala Ala Glu
85 90 95

Ala Glu

<210> 599
<211> 277
<212> PRT
<213> Streptococcus pneumoniae

<400> 599

Met Gly Ile Arg Val Tyr Lys Pro Thr Thr Asn Gly Arg Arg Asn Met
1 5 10 15

```
Thr Ser Leu Asp Phe Ala Glu Ile Thr Thr Ser Thr Pro Glu Lys Ser
            20                  25                  30

Leu Leu Val Ala Leu Lys Ser Lys Ala Gly Arg Asn Asn Asn Gly Arg
        35                  40                  45

Ile Thr Val Arg His Gln Gly Gly Gly His Lys Arg Phe Tyr Arg Leu
    50                  55                  60

Val Asp Phe Lys Arg Asn Lys Asp Asn Val Glu Ala Val Val Lys Thr
65                  70                  75                  80

Ile Glu Tyr Asp Pro Asn Arg Ser Ala Asn Ile Ala Leu Val His Tyr
                85                  90                  95

Thr Asp Gly Val Lys Ala Tyr Ile Ile Ala Pro Lys Gly Leu Glu Val
            100                 105                 110

Gly Gln Arg Ile Val Ser Gly Pro Glu Ala Asp Ile Lys Val Gly Asn
        115                 120                 125

Ala Leu Pro Leu Ala Asn Ile Pro Val Gly Thr Leu Ile His Asn Ile
    130                 135                 140

Glu Leu Lys Pro Gly Arg Gly Gly Glu Leu Val Arg Ala Ala Gly Ala
145                 150                 155                 160

Ser Ala Gln Val Leu Gly Ser Glu Gly Lys Tyr Val Leu Val Arg Leu
                165                 170                 175

Gln Ser Gly Glu Val Arg Met Ile Leu Gly Thr Cys Arg Ala Thr Val
            180                 185                 190

Gly Val Val Gly Asn Glu Gln His Gly Leu Val Asn Leu Gly Lys Ala
        195                 200                 205

Gly Arg Ser Arg Trp Lys Gly Ile Arg Pro Thr Val Arg Gly Ser Val
    210                 215                 220

Met Asn Pro Asn Asp His Pro His Gly Gly Gly Glu Gly Lys Ala Pro
225                 230                 235                 240
```

Val Gly Arg Lys Ala Pro Ser Thr Pro Trp Gly Lys Pro Ala Leu Gly
245 250 255

Leu Lys Thr Arg Asn Lys Lys Ala Lys Ser Asp Lys Leu Ile Val Arg
260 265 270

Arg Arg Asn Glu Lys
275

<210> 600
<211> 93
<212> PRT
<213> Streptococcus pneumoniae

<400> 600

Met Gly Arg Ser Leu Lys Lys Gly Pro Phe Val Asp Glu His Leu Met
1 5 10 15

Lys Lys Val Glu Ala Gln Ala Asn Asp Glu Lys Lys Lys Val Ile Lys
20 25 30

Thr Trp Ser Arg Arg Ser Thr Ile Phe Pro Ser Phe Ile Gly Tyr Thr
35 40 45

Ile Ala Val Tyr Asp Gly Arg Lys His Val Pro Val Tyr Ile Gln Glu
50 55 60

Asp Met Val Gly His Lys Leu Gly Glu Phe Ala Pro Thr Arg Thr Tyr
65 70 75 80

Lys Gly His Ala Ala Asp Asp Lys Lys Thr Arg Arg Lys
85 90

<210> 601
<211> 114
<212> PRT
<213> Streptococcus pneumoniae

<400> 601

Met Ala Glu Ile Thr Ser Ala Lys Ala Met Ala Arg Thr Val Arg Val
1 5 10 15

Ser Pro Arg Lys Ser Arg Leu Val Leu Asp Asn Ile Arg Gly Lys Ser
20 25 30

Val Ala Asp Ala Ile Ala Ile Leu Thr Phe Thr Pro Asn Lys Ala Ala
35 40 45

Glu Ile Ile Leu Lys Val Leu Asn Ser Ala Val Ala Asn Ala Glu Asn
50 55 60

Asn Phe Gly Leu Asp Lys Ala Asn Leu Val Val Ser Glu Ala Phe Ala
65 70 75 80

Asn Glu Gly Pro Thr Met Lys Arg Phe Arg Pro Arg Ala Lys Gly Ser
85 90 95

Ala Ser Pro Ile Asn Lys Arg Thr Ala His Ile Thr Val Ala Val Ala
100 105 110

Glu Lys

<210> 602
<211> 217
<212> PRT
<213> Streptococcus pneumoniae

<400> 602

Met Gly Gln Lys Val His Pro Ile Gly Met Arg Val Gly Ile Ile Arg
1 5 10 15

Asp Trp Asp Ala Lys Trp Tyr Ala Glu Lys Glu Tyr Ala Asp Tyr Leu
20 25 30

His Glu Asp Leu Ala Ile Arg Lys Phe Val Gln Lys Glu Leu Ala Asp
35 40 45

Ala Ala Val Ser Thr Ile Glu Ile Glu Arg Ala Val Asn Lys Val Asn
50 55 60

Val Ser Leu His Thr Ala Lys Pro Gly Met Val Ile Gly Lys Gly Gly
65 70 75 80

Ala Asn Val Asp Ala Leu Arg Ala Lys Leu Asn Lys Leu Thr Gly Lys
85 90 95

Gln Val His Ile Asn Ile Ile Glu Ile Lys Gln Pro Asp Leu Asp Ala
100 105 110

His Leu Val Gly Glu Gly Ile Ala Arg Gln Leu Glu Gln Arg Val Ala
115 120 125

Phe Arg Arg Ala Gln Lys Gln Ala Ile Gln Arg Ala Met Arg Ala Gly
130 135 140

Ala Lys Gly Ile Lys Thr Gln Val Ser Gly Arg Leu Asn Gly Ala Asp
145 150 155 160

Ile Ala Arg Ala Glu Gly Tyr Ser Glu Gly Thr Val Pro Leu His Thr
165 170 175

Leu Arg Ala Asp Ile Asp Tyr Ala Trp Glu Glu Ala Asp Thr Thr Tyr
180 185 190

Gly Lys Leu Gly Val Lys Val Trp Ile Tyr Arg Gly Glu Val Leu Pro
195 200 205

Ala Arg Lys Asn Thr Lys Gly Gly Lys
210 215

<210> 603
<211> 122
<212> PRT
<213> Streptococcus pneumoniae

<400> 603

Met Ile Gln Thr Glu Thr Arg Leu Lys Val Ala Asp Asn Ser Gly Ala
1 5 10 15

Arg Glu Ile Leu Thr Ile Lys Val Leu Gly Gly Ser Gly Arg Lys Phe
20 25 30

Ala Asn Ile Gly Asp Val Ile Val Ala Ser Val Lys Gln Ala Thr Pro
35 40 45

Gly Gly Ala Val Lys Lys Gly Asp Val Val Lys Ala Val Ile Val Arg
50 55 60

Thr Lys Ser Gly Ala Arg Arg Ala Asp Gly Ser Tyr Ile Lys Phe Asp
65 70 75 80

Glu Asn Ala Ala Val Ile Ile Arg Glu Asp Lys Thr Pro Arg Gly Thr
85 90 95

Arg Ile Phe Gly Pro Val Ala Arg Glu Leu Arg Glu Gly Gly Phe Met
100 105 110

Lys Ile Val Ser Leu Ala Pro Glu Val Leu
115 120

<210> 604
<211> 101
<212> PRT
<213> Streptococcus pneumoniae

<400> 604

Met Phe Val Lys Lys Gly Asp Lys Val Arg Val Ile Ala Gly Lys Asp
1 5 10 15

Lys Gly Thr Glu Ala Val Val Leu Thr Ala Leu Pro Lys Val Asn Lys
20 25 30

Val Ile Val Glu Gly Val Asn Ile Val Lys Lys His Gln Arg Pro Thr
35 40 45

Asn Glu Leu Pro Gln Gly Gly Ile Ile Glu Lys Glu Ala Ala Ile His
50 55 60

Val Ser Asn Val Gln Val Leu Asp Lys Asn Gly Val Ala Gly Arg Val
65 70 75 80

Gly Tyr Lys Phe Val Asp Gly Lys Lys Val Arg Tyr Asn Lys Lys Ser
85 90 95

Gly Glu Val Leu Asp
100

<210> 605
<211> 180
<212> PRT
<213> Streptococcus pneumoniae

<400> 605

Met Ala Asn Arg Leu Lys Glu Lys Tyr Leu Asn Glu Val Val Pro Ala
1 5 10 15

Leu Thr Glu Gln Phe Asn Tyr Ser Ser Val Met Ala Val Pro Lys Val
20 25 30

Asp Lys Ile Val Leu Asn Met Gly Val Gly Glu Ala Val Ser Asn Ala
35 40 45

Lys Ser Leu Glu Lys Ala Ala Glu Glu Leu Ala Leu Ile Ser Gly Gln
50 55 60

Lys Pro Leu Ile Thr Lys Ala Lys Lys Ser Ile Ala Gly Phe Arg Leu
65 70 75 80

Arg Glu Gly Val Ala Ile Gly Ala Lys Val Thr Leu Arg Gly Glu Arg
85 90 95

Met Tyr Glu Phe Leu Asp Lys Leu Val Ser Val Ser Leu Pro Arg Val
100 105 110

Arg Asp Phe His Gly Val Pro Thr Lys Ser Phe Asp Gly Arg Gly Asn
115 120 125

Tyr Thr Leu Gly Val Lys Glu Gln Leu Ile Phe Pro Glu Ile Asn Phe
130 135 140

Asp Asp Val Asp Lys Thr Arg Gly Leu Asp Ile Val Ile Val Thr Thr
145 150 155 160

Ala Asn Thr Asp Glu Glu Ser Arg Ala Leu Leu Thr Gly Leu Gly Met
165 170 175

Pro Phe Ala Lys
180

<210> 606
<211> 132
<212> PRT
<213> Streptococcus pneumoniae

<400> 606

Met Val Met Thr Asp Pro Ile Ala Asp Phe Leu Thr Arg Ile Arg Asn
1 5 10 15

Ala Asn Gln Ala Lys His Glu Val Leu Glu Val Pro Ala Ser Asn Ile
20 25 30

Lys Lys Gly Ile Ala Glu Ile Leu Lys Arg Glu Gly Phe Val Lys Asn
35 40 45

Val Glu Ile Ile Glu Asp Asp Lys Gln Gly Val Ile Arg Val Phe Leu
50 55 60

Lys Tyr Gly Pro Asn Gly Glu Lys Val Ile Thr Asn Leu Lys Arg Val
65 70 75 80

Ser Lys Pro Gly Leu Arg Val Tyr Lys Lys Arg Glu Asp Leu Pro Lys
85 90 95

Val Leu Asn Gly Leu Gly Ile Ala Ile Leu Ser Thr Ser Glu Gly Leu
100 105 110

Leu Thr Asp Lys Glu Ala Arg Gln Lys Asn Val Gly Gly Glu Val Ile
115 120 125

Ala Tyr Val Trp
130

<210> 607
<211> 178
<212> PRT
<213> Streptococcus pneumoniae

<400> 607

Met Ser Arg Ile Gly Asn Lys Val Ile Val Leu Pro Ala Gly Val Glu
1 5 10 15

Leu Ala Asn Asn Asp Asn Val Val Thr Val Lys Gly Ser Lys Gly Glu
20 25 30

Leu Thr Arg Glu Phe Ser Lys Asp Ile Glu Ile Arg Val Glu Gly Thr
35 40 45

Glu Ile Thr Leu His Arg Pro Asn Asp Ser Lys Glu Met Lys Thr Ile
50 55 60

His Gly Thr Thr Arg Ala Leu Leu Asn Asn Met Val Val Gly Val Ser
65 70 75 80

Glu Gly Phe Lys Lys Glu Leu Glu Met Arg Gly Val Gly Tyr Arg Ala
85 90 95

Gln Leu Gln Gly Ser Lys Leu Val Leu Ala Val Gly Lys Ser His Pro
100 105 110

Asp Glu Val Glu Ala Pro Glu Gly Ile Thr Phe Glu Leu Pro Asn Pro
115 120 125

Thr Thr Ile Val Val Ser Gly Ile Ser Lys Glu Val Val Gly Gln Thr
130 135 140

Ala Ala Tyr Val Arg Ser Leu Arg Ser Pro Glu Pro Tyr Lys Gly Lys
145 150 155 160

Gly Ile Arg Tyr Val Gly Glu Phe Val Arg Arg Lys Glu Gly Lys Thr
165 170 175

Gly Lys

<210> 608
<211> 118
<212> PRT
<213> Streptococcus pneumoniae

<400> 608

Met Ile Ser Lys Pro Asp Lys Asn Lys Leu Arg Gln Lys Arg His Arg
1 5 10 15

Arg Val Arg Gly Lys Leu Ser Gly Thr Ala Asp Arg Pro Arg Leu Asn
20 25 30

Val Phe Arg Ser Asn Thr Gly Ile Tyr Ala Gln Val Ile Asp Asp Val
35 40 45

Ala Gly Val Thr Leu Ala Ser Ala Ser Thr Leu Asp Lys Glu Val Ser
50 55 60

Lys Gly Thr Lys Thr Glu Gln Ala Val Ala Val Gly Lys Leu Val Ala
65 70 75 80

Glu Arg Ala Asn Ala Lys Gly Ile Ser Glu Val Val Phe Asp Arg Gly
85 90 95

Gly Tyr Leu Tyr His Gly Arg Val Lys Ala Leu Ala Asp Ala Ala Arg
100 105 110

Glu Asn Gly Leu Lys Phe
115

<210> 609
<211> 164
<212> PRT
<213> Streptococcus pneumoniae

<400> 609

Met Ala Phe Lys Asp Asn Ala Val Glu Leu Glu Glu Arg Val Val Ala
1 5 10 15

Val Asn Arg Val Thr Lys Val Val Lys Gly Gly Arg Arg Leu Arg Phe
20 25 30

Ala Ala Leu Val Val Val Gly Asp His Asn Gly Arg Val Gly Phe Gly
35 40 45

Thr Gly Lys Ala Gln Glu Val Pro Glu Ala Ile Arg Lys Ala Val Asp
50 55 60

Asp Ala Lys Lys Asn Leu Ile Glu Val Pro Met Val Gly Thr Thr Ile
65 70 75 80

Pro His Glu Val Leu Ser Glu Phe Gly Gly Ala Lys Val Leu Leu Lys
85 90 95

Pro Ala Val Glu Gly Ser Gly Val Ala Ala Gly Gly Ala Val Arg Ala
100 105 110

Val Val Glu Leu Ala Gly Val Ala Asp Ile Thr Ser Lys Ser Leu Gly
115 120 125

Ser Asn Thr Pro Ile Asn Ile Val Arg Ala Thr Val Glu Gly Leu Lys
130 135 140

Gln Leu Lys Arg Ala Glu Glu Ile Ala Ala Leu Arg Gly Ile Ser Val
145 150 155 160

Ser Asp Leu Ala

<210> 610
<211> 146
<212> PRT
<213> Streptococcus pneumoniae

<400> 610

Met Lys Leu His Glu Leu Lys Pro Ala Glu Gly Ser Arg Lys Val Arg
1 5 10 15

Asn Arg Val Gly Arg Gly Thr Ser Ser Gly Asn Gly Lys Thr Ser Gly
20 25 30

Arg Gly Gln Lys Gly Gln Lys Ala Arg Ser Gly Gly Gly Val Arg Leu
35 40 45

Gly Phe Glu Gly Gly Gln Thr Pro Leu Phe Arg Arg Leu Pro Lys Arg
50 55 60

Gly Phe Thr Asn Ile Asn Ala Lys Glu Tyr Ala Ile Val Asn Leu Asp
65 70 75 80

Gln Leu Asn Val Phe Glu Asp Gly Ala Glu Val Thr Pro Val Val Leu
85 90 95

Ile Glu Ala Gly Ile Val Lys Ala Glu Lys Ser Gly Ile Lys Ile Leu
100 105 110

Gly Asn Gly Glu Leu Thr Lys Lys Leu Thr Val Lys Ala Ala Lys Phe
115 120 125

Ser Lys Ser Ala Glu Glu Ala Ile Thr Ala Lys Gly Gly Ser Val Glu
130 135 140

Val Ile
145

<210> 611
<211> 436
<212> PRT
<213> Streptococcus pneumoniae

<400> 611

Met Phe Phe Lys Leu Leu Arg Glu Ala Leu Lys Val Lys Gln Val Arg
1 5 10 15

Ser Lys Ile Leu Phe Thr Ile Phe Ile Val Leu Val Phe Arg Ile Gly
20 25 30

Thr Ser Ile Thr Val Pro Gly Val Asn Ala Asn Ser Leu Asn Ala Leu
35 40 45

Ser Gly Leu Ser Phe Leu Asn Met Leu Ser Leu Val Ser Gly Asn Ala
50 55 60

Leu Lys Asn Phe Ser Ile Phe Ala Leu Gly Val Ser Pro Tyr Ile Thr
65 70 75 80

Ala Ser Ile Val Val Gln Leu Leu Gln Met Asp Ile Leu Pro Lys Phe
85 90 95

Val Glu Trp Gly Lys Gln Gly Glu Val Gly Arg Arg Lys Leu Asn Gln
100 105 110

Ala Thr Arg Tyr Ile Ala Leu Val Leu Ala Phe Val Gln Ser Ile Gly
115 120 125

Ile Thr Ala Gly Phe Asn Thr Leu Ala Gly Ala Gln Leu Ile Lys Thr
130 135 140

Ala Leu Thr Pro Gln Val Phe Leu Thr Ile Gly Ile Ile Leu Thr Ala
145 150 155 160

Gly Ser Met Ile Val Thr Trp Leu Gly Glu Gln Ile Thr Asp Lys Gly
165 170 175

Tyr Gly Asn Gly Val Ser Met Ile Ile Phe Ala Gly Ile Val Ser Ser
180 185 190

Ile Pro Glu Met Ile Gln Gly Ile Tyr Val Asp Tyr Phe Val Asn Val
195 200 205

Pro Ser Ser Arg Ile Thr Ser Ser Ile Ile Phe Val Ile Ile Leu Ile
210 215 220

Ile Thr Val Leu Leu Ile Ile Tyr Phe Thr Thr Tyr Val Gln Gln Ala
225 230 235 240

Glu Tyr Lys Ile Pro Ile Gln Tyr Thr Lys Val Ala Gln Gly Ala Pro
245 250 255

Ser Ser Ser Tyr Leu Pro Leu Lys Val Asn Pro Ala Gly Val Ile Pro
260 265 270

Val Ile Phe Ala Ser Ser Ile Thr Ala Ala Pro Ala Ala Ile Leu Gln
275 280 285

Phe Leu Ser Ala Thr Gly His Asp Trp Ala Trp Val Arg Val Ala Gln
290 295 300

Glu Met Leu Ala Thr Thr Ser Pro Thr Gly Ile Ala Met Tyr Ala Leu
305 310 315 320

Leu Ile Ile Leu Phe Thr Phe Phe Tyr Thr Phe Val Gln Ile Asn Pro
325 330 335

Glu Lys Ala Ala Glu Ser Leu Gln Lys Ser Gly Ala Tyr Ile His Gly
340 345 350

Val Arg Pro Gly Lys Gly Thr Glu Glu Tyr Met Ser Lys Leu Leu Arg
355 360 365

Arg Leu Ala Thr Val Gly Ser Leu Phe Leu Gly Val Ile Ser Ile Leu
370 375 380

Pro Ile Ala Ala Lys Asp Val Phe Gly Leu Ser Asp Val Val Ala Phe
385 390 395 400

Gly Gly Thr Ser Leu Leu Ile Ile Ile Ser Thr Gly Ile Glu Gly Ile
405 410 415

Lys Gln Leu Glu Gly Tyr Leu Leu Lys Arg Lys Tyr Val Gly Phe Met
420 425 430

Asp Arg Thr Glu
435

<210> 612
<211> 212
<212> PRT
<213> Streptococcus pneumoniae

<400> 612

Met Asn Leu Leu Ile Met Gly Leu Pro Gly Ala Gly Lys Gly Thr Gln
1 5 10 15

Ala Ala Lys Ile Val Glu Gln Phe His Val Ala His Ile Ser Thr Gly
20 25 30

Asp Met Phe Arg Ala Ala Met Ala Asn Gln Thr Glu Met Gly Val Leu
35 40 45

Ala Lys Ser Tyr Ile Asp Lys Gly Glu Leu Val Pro Asp Glu Val Thr
50 55 60

Asn Gly Ile Val Lys Glu Arg Leu Ser Gln Asp Asp Ile Lys Glu Thr
65 70 75 80

Gly Phe Leu Leu Asp Gly Tyr Pro Arg Thr Ile Glu Gln Ala His Ala
85 90 95

Leu Asp Lys Thr Leu Ala Glu Leu Gly Ile Glu Leu Glu Gly Val Ile
100 105 110

Asn Ile Glu Val Asn Pro Asp Ser Leu Leu Glu Arg Leu Ser Gly Arg
115 120 125

Ile Ile His Arg Val Thr Gly Glu Thr Phe His Lys Val Phe Asn Pro
130 135 140

Pro Val Asp Tyr Lys Glu Glu Asp Tyr Tyr Gln Arg Glu Asp Asp Lys
145 150 155 160

Pro Glu Thr Val Lys Arg Arg Leu Asp Val Asn Ile Ala Gln Gly Glu
165 170 175

Pro Ile Ile Ala His Tyr Arg Ala Lys Gly Leu Val His Asp Ile Glu
180 185 190

Gly Asn Gln Asp Ile Asn Asp Val Phe Ser Asp Ile Glu Lys Val Leu
195 200 205

Thr Asn Leu Lys
210

<210> 613
<211> 121
<212> PRT
<213> Streptococcus pneumoniae

<400> 613

Met Ala Arg Ile Ala Gly Val Asp Ile Pro Asn Asp Lys Arg Val Val
1 5 10 15

Ile Ser Leu Thr Tyr Val Tyr Gly Ile Gly Leu Ala Thr Ser Lys Lys
20 25 30

Ile Leu Ala Ala Ala Gly Ile Ser Glu Asp Val Arg Val Arg Asp Leu
35 40 45

Thr Ser Asp Gln Glu Asp Ala Ile Arg Arg Glu Val Asp Ala Ile Lys
50 55 60

Val Glu Gly Asp Leu Arg Arg Glu Val Asn Leu Asn Ile Lys Arg Leu
65 70 75 80

Met Glu Ile Gly Ser Tyr Arg Gly Ile Arg His Arg Arg Gly Leu Pro
85 90 95

Val Arg Gly Gln Asn Thr Lys Asn Asn Ala Arg Thr Arg Lys Gly Lys
100 105 110

Ala Val Ala Ile Ala Gly Lys Lys Lys
115 120

<210> 614
<211> 127
<212> PRT
<213> Streptococcus pneumoniae

<400> 614

Met Ala Lys Pro Thr Arg Lys Arg Arg Val Lys Lys Asn Ile Glu Ser
1 5 10 15

Gly Ile Ala His Ile His Ala Thr Phe Asn Asn Thr Ile Val Met Ile
20 25 30

Thr Asp Val His Gly Asn Ala Ile Ala Trp Ser Ser Ala Gly Ala Leu
35 40 45

Gly Phe Lys Gly Ser Arg Lys Ser Thr Pro Phe Ala Ala Gln Met Ala
50 55 60

Ser Glu Ala Ala Ala Lys Ser Ala Gln Glu His Gly Leu Lys Ser Val
65 70 75 80

Glu Val Thr Val Lys Gly Pro Gly Ser Gly Arg Glu Ser Ala Ile Arg
85 90 95

Ala Leu Ala Ala Ala Gly Leu Glu Val Thr Ala Ile Arg Asp Val Thr
100 105 110

Pro Val Pro His Asn Gly Ala Arg Pro Pro Lys Arg Arg Arg Val
115 120 125

<210> 615
<211> 128
<212> PRT
<213> Streptococcus pneumoniae

<400> 615

Met Ala Tyr Arg Lys Leu Gly Arg Thr Ser Ser Gln Arg Lys Ala Met
1 5 10 15

Leu Arg Asp Leu Thr Thr Asp Leu Leu Ile Asn Glu Ser Ile Val Thr
20 25 30

Thr Glu Ala Arg Ala Lys Glu Ile Arg Lys Thr Val Glu Lys Met Ile
35 40 45

Thr Leu Gly Lys Arg Gly Asp Leu His Ala Arg Arg Gln Ala Ala Ala
50 55 60

Phe Val Arg Asn Glu Ile Ala Ser Glu Asn Tyr Asp Glu Ala Thr Asp
65 70 75 80

Lys Tyr Thr Ser Thr Thr Ala Leu Gln Lys Leu Phe Ser Glu Ile Ala
85 90 95

Pro Arg Tyr Ala Glu Arg Asn Gly Gly Tyr Thr Arg Ile Leu Lys Thr
100 105 110

Glu Ser Arg Arg Gly Asp Ala Ala Pro Met Ala Ile Ile Glu Leu Val
115 120 125

<210> 616
<211> 137
<212> PRT
<213> Streptococcus pneumoniae

<400> 616

Met Pro Thr Ile Asn Gln Leu Val Arg Lys Pro Arg Lys Ser Lys Val
1 5 10 15

Glu Lys Ser Lys Ser Pro Ala Leu Asn Val Gly Tyr Asn Ser His Lys
20 25 30

```
Lys Val Gln Thr Asn Val Ser Ser Pro Gln Lys Arg Gly Val Ala Thr
        35                  40                  45

Arg Val Gly Thr Met Thr Pro Lys Lys Pro Asn Ser Ala Leu Arg Lys
    50                  55                  60

Phe Ala Arg Val Arg Leu Ser Asn Leu Ile Glu Val Thr Ala Tyr Ile
65                  70                  75                  80

Pro Gly Ile Gly His Asn Leu Gln Glu His Ser Val Val Leu Leu Arg
                85                  90                  95

Gly Gly Arg Val Lys Asp Leu Pro Gly Val Arg Tyr His Ile Val Arg
            100                 105                 110

Gly Ala Leu Asp Thr Ala Gly Val Asn Asp Arg Lys Gln Gly Arg Ser
        115                 120                 125

Lys Tyr Gly Thr Lys Arg Pro Lys Ala
    130                 135
```

<210> 617
<211> 156
<212> PRT
<213> Streptococcus pneumoniae

<400> 617

```
Met Ser Arg Lys Asn Arg Ala Pro Lys Arg Asp Val Leu Pro Asp Pro
1               5                   10                  15

Leu Tyr Asn Ser Gln Leu Val Thr Arg Leu Ile Asn Arg Val Met Leu
            20                  25                  30

Asp Gly Lys Arg Gly Thr Ala Ala Ser Ile Val Tyr Gly Ala Phe Glu
        35                  40                  45

Gln Ile Lys Glu Ala Thr Gly Asn Asp Ala Leu Glu Val Phe Glu Thr
    50                  55                  60

Ala Met Glu Asn Ile Met Pro Val Leu Glu Val Arg Ala Arg Arg Val
65                  70                  75                  80
```

Gly Gly Ser Asn Tyr Gln Val Pro Val Lys Val Arg Pro Glu Arg Arg
85 90 95

Thr Thr Leu Gly Leu Arg Trp Leu Val Thr Ile Ala Arg Leu Arg Gly
100 105 110

Glu His Thr Met Gln Asp Arg Leu Ala Lys Glu Ile Leu Asp Ala Ala
115 120 125

Asn Asn Thr Gly Ala Ala Val Lys Lys Arg Glu Asp Thr His Arg Met
130 135 140

Ala Glu Ala Asn Arg Ala Phe Ala His Phe Arg Trp
145 150 155

<210> 618
<211> 303
<212> PRT
<213> Streptococcus pneumoniae

<400> 618

Met Thr Glu Lys Leu Gln Leu Thr Lys Ser Asp Arg Lys Lys Val Trp
1 5 10 15

Trp Arg Ser Thr Phe Leu Gln Gly Ser Trp Asn Phe Glu Arg Met Gln
20 25 30

Asn Leu Gly Trp Ala Tyr Thr Leu Ile Pro Ala Ile Lys Lys Leu Tyr
35 40 45

Thr Lys Lys Glu Asp Gln Ile Ala Ala Leu Glu Arg His Leu Glu Phe
50 55 60

Phe Asn Thr His Pro Tyr Val Ala Ala Pro Val Met Gly Val Thr Leu
65 70 75 80

Ala Leu Glu Glu Glu Arg Ala Asn Gly Val Glu Ile Asp Asp Ala Ala
85 90 95

Ile Gln Gly Val Lys Ile Gly Met Met Gly Pro Leu Ala Gly Ile Gly
100 105 110

Asp Pro Val Phe Trp Phe Thr Val Arg Pro Ile Leu Gly Ser Leu Gly
115 120 125

Ala Ser Leu Ala Leu Thr Gly Asn Ile Leu Gly Pro Leu Leu Phe Phe
130 135 140

Val Ala Trp Asn Leu Ile Arg Met Ser Phe Leu Trp Tyr Val Gln Glu
145 150 155 160

Ile Gly Tyr Lys Ala Gly Ser Glu Ile Thr Lys Asp Met Ser Gly Gly
165 170 175

Ile Leu Gln Asp Ile Thr Lys Gly Ala Ser Ile Leu Gly Met Phe Ile
180 185 190

Leu Ala Val Leu Val Gln Arg Trp Val Asn Ile Lys Phe Ala Phe Asp
195 200 205

Val Ser Lys Val Gln Leu Asp Glu Lys Ala Tyr Ile His Trp Asp Lys
210 215 220

Leu Pro Glu Gly Ser Lys Gly Ile Gln Glu Ala Phe Ala Gln Val Gly
225 230 235 240

Gln Gly Leu Ser Gln Thr Pro Glu Lys Val Thr Thr Phe Gln Gln Asn
245 250 255

Leu Asp Met Leu Ile Pro Gly Leu Ser Gly Leu Leu Leu Thr Leu Leu
260 265 270

Cys Met Tyr Leu Leu Lys Lys Lys Val Ser Pro Ile Thr Ile Ile Leu
275 280 285

Ala Leu Phe Ala Val Gly Ile Val Ala His Val Leu His Ile Met
290 295 300

<210> 619
<211> 267
<212> PRT
<213> Streptococcus pneumoniae

<400> 619

```
Met Ser Ile Ile Ser Met Val Leu Val Val Val Val Ala Phe Phe Ala
1               5                   10                  15

Gly Leu Glu Gly Ile Leu Asp Gln Phe Gln Phe His Gln Pro Leu Val
            20                  25                  30

Ala Cys Thr Leu Ile Gly Leu Val Thr Gly His Leu Glu Ala Gly Ile
        35                  40                  45

Ile Leu Gly Gly Ser Leu Gln Met Ile Ala Leu Gly Trp Ser Asn Ile
    50                  55                  60

Gly Ala Ala Ile Ala Pro Asp Ala Ala Leu Ala Ser Val Ala Ala Ala
65                  70                  75                  80

Ile Ile Met Val Leu Gly Gly Asp Phe Thr Lys Thr Gly Ile Gly Val
                85                  90                  95

Ala Gln Ala Val Ala Ile Pro Leu Ala Val Ala Gly Leu Phe Leu Thr
            100                 105                 110

Met Ile Val Arg Thr Ile Ser Val Gly Leu Val His Thr Ala Asp Ala
        115                 120                 125

Ala Ala Lys Lys Gly Asp Phe Gly Ala Val Glu Arg Ala His Phe Ile
    130                 135                 140

Ala Leu Leu Phe Gln Gly Leu Arg Ile Ala Leu Pro Ala Ala Leu Leu
145                 150                 155                 160

Leu Met Val Pro Thr Glu Thr Val Gln Ser Ile Leu Ser Ala Met Pro
                165                 170                 175

Asp Trp Leu Lys Asp Gly Met Ala Ile Gly Gly Gly Met Val Val Ala
            180                 185                 190

Val Gly Tyr Ala Met Val Ile Asn Met Met Ala Thr Arg Glu Val Trp
        195                 200                 205

Pro Phe Phe Ala Leu Gly Phe Val Leu Ala Ala Val Ser Asp Ile Thr
    210                 215                 220
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Leu Ile Gly Phe Gly Ala Ile Gly Val Ala Ile Ala Leu Ile Tyr Leu
225 230 235 240

His Leu Ser Lys Thr Gly Gly Asn Gly Gly Gly Gly Ala Ala Thr Ser
245 250 255

Asn Asp Pro Ile Gly Asp Ile Leu Glu Asp Tyr
260 265

<210> 620
<211> 332
<212> PRT
<213> Streptococcus pneumoniae

<400> 620

Met Thr Ile Met Ser Ile Gly Ile Ile Ile Ala Ser His Gly Glu Phe
1 5 10 15

Ala Ala Gly Ile His Gln Ser Gly Ser Met Ile Phe Gly Glu Gln Glu
20 25 30

Lys Val Gln Val Val Thr Phe Met Pro Asn Glu Gly Pro Asp Asp Leu
35 40 45

Tyr Ala Lys Phe Asn Asn Ala Val Ala Ala Phe Asp Ala Glu Asp Glu
50 55 60

Val Leu Val Leu Ala Asp Leu Trp Ser Gly Ser Pro Phe Asn Gln Ala
65 70 75 80

Ser Arg Val Met Gly Glu Asn Pro Glu Arg Lys Phe Ala Ile Ile Thr
85 90 95

Gly Leu Asn Leu Pro Met Leu Ile Gln Ala Tyr Thr Glu Arg Leu Met
100 105 110

Asp Ala Ala Ala Gly Val Glu Lys Val Ala Ala Asn Ile Ile Lys Glu
115 120 125

Ala Lys Asp Gly Ile Lys Ala Leu Pro Glu Glu Leu Asn Pro Val Glu
130 135 140

Glu Val Ala Ser Ala Ala Ala Ala Pro Val Ala Gln Thr Ala Ile Pro
145 150 155 160

Glu Gly Thr Val Ile Gly Asp Gly Lys Leu Lys Ile Asn Leu Ala Arg
165 170 175

Leu Asp Thr Arg Leu Leu His Gly Gln Val Ala Thr Ala Trp Thr Pro
180 185 190

Asp Ser Lys Ala Asn Arg Ile Ile Val Ala Ser Asp Asn Val Ala Lys
195 200 205

Asp Asp Leu Arg Lys Glu Leu Ile Lys Gln Ala Ala Pro Gly Asn Val
210 215 220

Lys Ala Asn Val Val Pro Ile Gln Lys Leu Ile Glu Ile Ser Lys Asp
225 230 235 240

Pro Arg Phe Gly Glu Thr His Ala Leu Ile Leu Phe Glu Thr Pro Gln
245 250 255

Asp Ala Leu Arg Ala Ile Glu Gly Gly Val Pro Ile Lys Thr Leu Asn
260 265 270

Val Gly Ser Met Ala His Ser Thr Gly Lys Thr Leu Val Asn Thr Val
275 280 285

Leu Ser Met Asp Lys Glu Asp Val Ala Thr Phe Glu Lys Met Arg Asp
290 295 300

Leu Gly Val Glu Phe Asp Val Arg Lys Val Pro Asn Asp Ser Lys Lys
305 310 315 320

Asp Leu Phe Asp Leu Ile Asn Lys Ala Asn Val Lys
325 330

<210> 621
<211> 339
<212> PRT
<213> Streptococcus pneumoniae

<400> 621

Met Lys Ala Val Val Val Asn Pro Glu Ser Thr Gly Val Ala Ile Glu
1 5 10 15

Glu Lys Val Leu Arg Pro Leu Glu Thr Gly Glu Ala Leu Val Glu Val
20 25 30

Glu Tyr Cys Gly Val Cys His Thr Asp Leu His Val Ala His Gly Asp
35 40 45

Phe Gly Gln Val Pro Gly Arg Val Leu Gly His Glu Gly Ile Gly Ile
50 55 60

Val Lys Glu Ile Ala Pro Asp Val Lys Ser Leu Lys Val Gly Asp Arg
65 70 75 80

Val Ser Val Ala Trp Phe Phe Glu Gly Cys Gly Thr Cys Glu Tyr Cys
85 90 95

Thr Thr Gly Arg Glu Thr Leu Cys Arg Thr Val Lys Asn Ala Gly Tyr
100 105 110

Ser Val Asp Gly Gly Met Ala Glu Gln Cys Ile Val Thr Ala Asp Tyr
115 120 125

Ala Val Lys Val Pro Asp Gly Leu Asp Pro Ala Gln Ala Ser Ser Ile
130 135 140

Thr Cys Ala Gly Val Thr Thr Tyr Lys Ala Ile Lys Glu Ala Lys Val
145 150 155 160

Glu Pro Gly Gln Trp Val Val Leu Tyr Gly Ala Gly Gly Leu Gly Asn
165 170 175

Leu Ala Val Gln Tyr Ala Lys Lys Val Phe Asn Ala His Val Ile Ala
180 185 190

Val Asp Ile Asn Asn Asp Lys Leu Ala Leu Ala Lys Glu Val Gly Ala
195 200 205

Asp Ile Val Ile Asn Gly Leu Glu Val Glu Asp Val Ala Gly Leu Ile
210 215 220

Lys Glu Lys Thr Asp Gly Gly Ala His Ser Ala Val Val Thr Ala Val
225 230 235 240

Ser Lys Val Ala Phe Asn Gln Ala Val Asp Ser Ile Arg Ala Gly Gly
245 250 255

Arg Val Val Ala Val Gly Leu Pro Ser Glu Met Met Glu Leu Ser Ile
260 265 270

Val Lys Thr Val Leu Asp Gly Ile Gln Val Ile Gly Ser Leu Val Gly
275 280 285

Thr Arg Lys Asp Leu Glu Glu Ala Phe Gln Phe Gly Ala Glu Gly Leu
290 295 300

Val Val Pro Val Val Gln Lys Arg Pro Val Glu Asp Ala Val Ala Ile
305 310 315 320

Phe Asp Glu Met Glu Lys Gly Gln Ile Gln Gly Arg Met Val Leu Asp
325 330 335

Phe Thr His

<210> 622
<211> 148
<212> PRT
<213> Streptococcus pneumoniae

<400> 622

Met Asn Lys Thr Thr Phe Met Ala Lys Pro Gly Gln Val Glu Arg Lys
1 5 10 15

Trp Tyr Val Val Asp Ala Thr Asp Val Pro Leu Gly Arg Leu Ser Ala
20 25 30

Val Val Ala Ser Val Leu Arg Gly Lys Asn Lys Pro Thr Phe Thr Pro
35 40 45

His Thr Asp Thr Gly Asp Phe Val Ile Val Ile Asn Ala Glu Lys Val
50 55 60

Lys Leu Thr Gly Lys Lys Ala Thr Asp Lys Ile Tyr Tyr Thr His Ser
65 70 75 80

Asn His Pro Gly Gly Leu Lys Gln Ile Ser Ala Gly Glu Leu Arg Ser
85 90 95

Lys Asn Ala Val Arg Leu Ile Glu Lys Ser Val Lys Gly Met Leu Pro
100 105 110

His Asn Thr Leu Gly Arg Ala Gln Gly Met Lys Leu Lys Val Phe Val
115 120 125

Gly Ala Glu His Thr His Ala Ala Gln Gln Pro Glu Val Leu Asp Ile
130 135 140

Ser Gly Leu Ile
145

<210> 623
<211> 130
<212> PRT
<213> Streptococcus pneumoniae

<400> 623

Met Ser Gln Ala Gln Tyr Ala Gly Thr Gly Arg Arg Lys Asn Ala Val
1 5 10 15

Ala Arg Val Arg Leu Val Pro Gly Thr Gly Lys Ile Thr Val Asn Lys
20 25 30

Lys Asp Val Glu Glu Tyr Ile Pro His Ala Asp Leu Arg Leu Val Ile
35 40 45

Asn Gln Pro Phe Ala Val Thr Ser Thr Val Gly Ser Tyr Asp Val Phe
50 55 60

Val Asn Val Ile Gly Gly Gly Tyr Ala Gly Gln Ser Gly Ala Ile Arg
65 70 75 80

His Gly Ile Ala Arg Ala Leu Leu Gln Val Asp Pro Asp Phe Arg Asp
85 90 95

Ser Leu Lys Arg Ala Gly Leu Leu Thr Arg Asp Ser Arg Lys Val Glu
100 105 110

Arg Lys Lys Pro Gly Leu Lys Lys Ala Arg Lys Ala Ser Gln Phe Ser
115 120 125

Lys Arg
130

<210> 624
<211> 272
<212> PRT
<213> Streptococcus pneumoniae

<400> 624

Met Thr Gly Ser Asn Lys Leu Thr Lys Arg Asp Tyr Leu Lys Thr Ser
1 5 10 15

Leu Arg Ala Phe Phe Cys Gln Asn Gly Phe Asn Tyr Ser Asn Tyr Gln
20 25 30

Gly Leu Gly Tyr Ala Asn Val Met Tyr Pro Ala Leu Lys Lys His Tyr
35 40 45

Gly Glu Asp Gln Glu Gly Phe Tyr Gln Ala Leu Glu Glu Asn Cys Glu
50 55 60

Phe Tyr Asn Thr Asn Pro His Phe Leu Pro Phe Ile Thr Ser Leu His
65 70 75 80

Leu Val Met Leu Glu Asn Gly Arg Pro Ala Lys Glu Thr Arg Ser Ile
85 90 95

Lys Met Ala Leu Met Gly Pro Leu Ala Gly Ile Gly Asp Ser Leu Ser
100 105 110

Gln Phe Cys Leu Ala Pro Leu Phe Ser Thr Ile Ala Ala Ser Phe Ala
115 120 125

Gln Glu Gly Leu Val Val Gly Pro Ile Leu Phe Phe Leu Ala Met Asn
130 135 140

Thr Ile Leu Thr Ala Ile Lys Leu Ser Thr Gly Leu Tyr Gly Tyr Lys
145 150 155 160

Leu Gly Thr Thr Val Ile Asp Lys Leu Ser Glu Gln Met Ala Thr Ile
165 170 175

Ser Arg Ile Ala Asn Ile Ile Gly Val Thr Val Ile Ala Gly Leu Ala
180 185 190

Ala Thr Ser Val Lys Ile Met Val Pro Ile Thr Phe Ala Ala Gly Glu
195 200 205

Val Lys Ala Asp Ala Lys Gln Ser Ile Val Ser Ile Gln Gly Met Leu
210 215 220

Asp Lys Val Ala Pro Ala Leu Leu Pro Ala Leu Phe Thr Leu Leu Val
225 230 235 240

Tyr Tyr Leu Ile Lys Glu Lys Lys Trp Thr Thr Tyr Lys Leu Val Ile
245 250 255

Leu Thr Val Ile Ile Gly Ile Ile Gly Ser Trp Leu Lys Ile Ile Ala
260 265 270

<210> 625
<211> 494
<212> PRT
<213> Streptococcus pneumoniae

<400> 625

Met Lys Lys Gln Ala Phe Ser Ser Glu Gln Tyr Leu Asn Leu Gln Arg
1 5 10 15

Asp His Ile Leu Glu Arg Ile Asn Gln Phe Asp Gly Lys Leu Tyr Leu
20 25 30

Glu Phe Gly Gly Lys Met Leu Glu Asp Phe His Ala Ala Arg Val Leu
35 40 45

Pro Gly Tyr Glu Pro Asp Asn Lys Ile Lys Leu Leu Gln Glu Leu Lys
50 55 60

Glu Gln Val Glu Val Val Ile Ala Ile Asn Ala Ser Asn Ile Glu His
65 70 75 80

Ser Lys Ala Arg Gly Asp Leu Gly Ile Ser Tyr Asp Gln Glu Val Leu
85 90 95

Arg Leu Ile Asp Lys Phe Asn Glu Leu Gly Ile Phe Val Gly Ser Val
100 105 110

Val Ile Thr Gln Tyr Ala Gly Gln Pro Ala Ala Asp Ala Phe Arg Asn
115 120 125

Gln Leu Glu Lys Asn Gly Ile Asp Ser Tyr Leu His Tyr Pro Ile Lys
130 135 140

Gly Tyr Pro Thr Asp Met Asp His Ile Ile Ser Pro Glu Gly Met Gly
145 150 155 160

Lys Asn Asp Tyr Ile Lys Thr Ser Arg Asn Leu Ile Val Val Thr Ala
165 170 175

Pro Gly Pro Gly Ser Gly Lys Leu Ala Thr Cys Met Ser Asn Met Tyr
180 185 190

His Asp Gln Ile Asn Gly Ile Lys Ser Gly Tyr Ala Lys Phe Glu Thr
195 200 205

Phe Pro Val Trp Asn Leu Pro Leu His His Pro Val Asn Leu Ala Tyr
210 215 220

Glu Ala Ala Thr Ala Asp Leu Asp Asp Val Asn Met Ile Asp Pro Phe
225 230 235 240

His Leu Gln Thr Tyr Gly Glu Thr Thr Val Asn Tyr Asn Arg Asp Ile
245 250 255

Glu Ile Phe Pro Val Leu Lys Arg Met Leu Glu Arg Ile Leu Gly Lys
260 265 270

Ser Pro Tyr Ala Ser Pro Thr Asp Met Gly Val Asn Met Val Gly Phe

275 280 285

Ala Ile Thr Asp Asp Glu Ala Ala Val Glu Ala Ser Lys Gln Glu Ile
290 295 300

Ile Arg Arg Tyr Tyr Gln Thr Val Leu Asp Phe Lys Ala Glu Lys Val
305 310 315 320

Gly Glu Ala Ala Val Lys Lys Ile Glu Leu Leu Met Asn Asp Leu Gly
325 330 335

Ile Thr Pro Ala Asp Arg Lys Val Ala Val Val Ala Arg Gln Lys Ala
340 345 350

Glu Glu Thr Gly Gly Pro Ala Leu Ala Phe Glu Leu Pro Asn Gly Glu
355 360 365

Ile Ile Thr Gly Lys Asn Ser Glu Leu Phe Gly Pro Thr Ala Ala Ala
370 375 380

Leu Ile Asn Ala Ile Lys Lys Ser Ala Asp Ile Ala Lys Glu Val Lys
385 390 395 400

Leu Ile Glu Pro Glu Val Val Lys Pro Ile Gln Gly Leu Lys Ile Asp
405 410 415

His Leu Gly Ser Arg Asn Pro Arg Leu His Ser Asn Glu Ile Leu Ile
420 425 430

Ala Leu Ala Ile Thr Ala Thr Glu Asn Pro Asp Ala Ala Arg Ala Met
435 440 445

Glu Glu Leu Gly Asn Leu Lys Gly Ser Glu Ala His Ser Thr Ile Ile
450 455 460

Leu Thr Asp Glu Asp Lys Asn Val Leu Arg Lys Leu Gly Ile Asn Val
465 470 475 480

Thr Phe Asp Pro Tyr Tyr Gln Tyr Asp Arg Leu Tyr Arg Lys
485 490

<210> 626
<211> 719
<212> PRT
<213> Streptococcus pneumoniae

<400> 626

Met Asn Lys Pro Thr Ile Leu Arg Leu Ile Lys Tyr Leu Ser Ile Ser
1   5   10   15

Phe Leu Ser Leu Val Ile Ala Ala Ile Val Leu Gly Gly Gly Val Phe
            20   25   30

Phe Tyr Tyr Val Ser Lys Ala Pro Ser Leu Ser Glu Ser Lys Leu Val
        35   40   45

Ala Thr Thr Ser Ser Lys Ile Tyr Asp Asn Lys Asn Gln Leu Ile Ala
    50   55   60

Asp Leu Gly Ser Glu Arg Arg Val Asn Ala Gln Ala Asn Asp Ile Pro
65   70   75   80

Thr Asp Leu Val Lys Ala Ile Val Ser Ile Glu Asp His Arg Phe Phe
                85   90   95

Asp His Arg Gly Ile Asp Thr Ile Arg Ile Leu Gly Ala Phe Leu Arg
            100   105   110

Asn Leu Gln Ser Asn Ser Leu Gln Gly Gly Ser Thr Leu Thr Gln Gln
        115   120   125

Leu Ile Lys Leu Thr Tyr Phe Ser Thr Ser Thr Ser Asp Gln Thr Ile
    130   135   140

Ser Arg Lys Ala Gln Glu Ala Trp Leu Ala Ile Gln Leu Glu Gln Lys
145   150   155   160

Ala Thr Lys Gln Glu Ile Leu Thr Tyr Tyr Ile Asn Lys Val Tyr Met
                165   170   175

Ser Asn Gly Asn Tyr Gly Met Gln Thr Ala Ala Gln Asn Tyr Tyr Gly
            180   185   190

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Lys Asp Leu Asn Asn Leu Ser Leu Pro Gln Leu Ala Leu Leu Ala Gly
        195                 200                 205

Met Pro Gln Ala Pro Asn Gln Tyr Asp Pro Tyr Ser His Pro Glu Ala
    210                 215                 220

Ala Gln Asp Arg Arg Asn Leu Val Leu Ser Glu Met Lys Asn Gln Gly
225                 230                 235                 240

Tyr Ile Ser Ala Glu Gln Tyr Glu Lys Ala Val Asn Thr Pro Ile Thr
                245                 250                 255

Asp Gly Leu Gln Ser Leu Lys Ser Ala Ser Asn Tyr Pro Ala Tyr Met
            260                 265                 270

Asp Asn Tyr Leu Lys Glu Val Ile Asn Gln Val Glu Glu Glu Thr Gly
        275                 280                 285

Tyr Asn Leu Leu Thr Thr Gly Met Asp Val Tyr Thr Asn Val Asp Gln
    290                 295                 300

Glu Ala Gln Lys His Leu Trp Asp Ile Tyr Asn Thr Asp Glu Tyr Val
305                 310                 315                 320

Ala Tyr Pro Asp Asp Glu Leu Gln Val Ala Ser Thr Ile Val Asp Val
                325                 330                 335

Ser Asn Gly Lys Val Ile Ala Gln Leu Gly Ala Arg His Gln Ser Ser
            340                 345                 350

Asn Val Ser Phe Gly Ile Asn Gln Ala Val Glu Thr Asn Arg Asp Trp
        355                 360                 365

Gly Ser Thr Met Lys Pro Ile Thr Asp Tyr Ala Pro Ala Leu Glu Tyr
    370                 375                 380

Gly Val Tyr Asp Ser Thr Ala Thr Ile Val His Asp Glu Pro Tyr Asn
385                 390                 395                 400

Tyr Pro Gly Thr Asn Thr Pro Val Tyr Asn Trp Asp Arg Gly Tyr Phe
                405                 410                 415
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Gly Asn Ile Thr Leu Gln Tyr Ala Leu Gln Gln Ser Arg Asn Val Pro
            420                 425                 430

Ala Val Glu Thr Leu Asn Lys Val Gly Leu Asn Arg Ala Lys Thr Phe
        435                 440                 445

Leu Asn Gly Leu Gly Ile Asp Tyr Pro Ser Ile His Tyr Ser Asn Ala
    450                 455                 460

Ile Ser Ser Asn Thr Thr Glu Ser Asp Lys Lys Tyr Gly Ala Ser Ser
465                 470                 475                 480

Glu Lys Met Ala Ala Ala Tyr Ala Ala Phe Ala Asn Gly Gly Thr Tyr
                485                 490                 495

Tyr Lys Pro Met Tyr Ile His Lys Val Val Phe Ser Asp Gly Ser Glu
            500                 505                 510

Lys Glu Phe Ser Asn Val Gly Thr Arg Ala Met Lys Glu Thr Thr Ala
        515                 520                 525

Tyr Met Met Thr Asp Met Met Lys Thr Val Leu Thr Tyr Gly Thr Gly
    530                 535                 540

Arg Asn Ala Tyr Leu Ala Trp Leu Pro Gln Ala Gly Lys Thr Gly Thr
545                 550                 555                 560

Ser Asn Tyr Thr Asp Glu Glu Ile Glu Asn His Ile Lys Thr Ser Gln
                565                 570                 575

Phe Val Ala Pro Asp Glu Leu Phe Ala Gly Tyr Thr Arg Lys Tyr Ser
            580                 585                 590

Met Ala Val Trp Thr Gly Tyr Ser Asn Arg Leu Thr Pro Leu Val Gly
        595                 600                 605

Asn Gly Leu Thr Val Ala Ala Lys Val Tyr Arg Ser Met Met Thr Tyr
    610                 615                 620

Leu Ser Glu Gly Ser Asn Pro Glu Asp Trp Asn Ile Pro Glu Gly Leu
625                 630                 635                 640
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Tyr Arg Asn Gly Glu Phe Val Phe Lys Asn Gly Ala Arg Ser Thr Trp
645 650 655

Asn Ser Pro Ala Pro Gln Gln Pro Pro Ser Thr Glu Ser Ser Ser Ser
660 665 670

Ser Ser Asp Ser Ser Thr Ser Gln Ser Ser Ser Thr Thr Pro Ser Thr
675 680 685

Asn Asn Ser Thr Thr Thr Asn Pro Asn Asn Asn Thr Gln Gln Ser Asn
690 695 700

Thr Thr Pro Asp Gln Gln Asn Gln Asn Pro Gln Pro Ala Gln Pro
705 710 715

<210> 627
<211> 113
<212> PRT
<213> Streptococcus pneumoniae

<400> 627

Met Glu Arg Asp Met Ala Ser Ile Ile Phe Ser Ala Lys Asp Ile Phe
1 5 10 15

Glu Gln Glu Phe Gly Arg Glu Val Arg Gly Tyr Asn Lys Val Glu Val
20 25 30

Asp Glu Phe Leu Asp Asp Val Ile Lys Asp Tyr Glu Thr Tyr Ala Ala
35 40 45

Leu Val Lys Ser Leu Arg Gln Glu Ile Ala Asp Leu Lys Glu Glu Leu
50 55 60

Thr Arg Lys Pro Lys Pro Ser Pro Val Gln Ala Glu Pro Leu Glu Ala
65 70 75 80

Ala Ile Thr Ser Ser Met Thr Asn Phe Asp Ile Leu Lys Arg Leu Asn
85 90 95

Arg Leu Glu Lys Glu Val Phe Gly Lys Gln Ile Leu Asp Asn Ser Asp
100 105 110

Phe

<210> 628
<211> 464
<212> PRT
<213> Streptococcus pneumoniae

<400> 628

Met Ser Lys Lys Arg Arg Asn Arg His Lys Lys Glu Gly Gln Glu Pro
1 5 10 15

Gln Phe Asp Phe Asp Glu Ala Lys Glu Leu Thr Val Gly Gln Ala Ile
20 25 30

Arg Lys Asn Glu Glu Val Glu Ser Gly Val Leu Pro Glu Asp Ser Ile
35 40 45

Leu Asp Lys Tyr Val Lys Gln His Arg Asp Glu Ile Glu Ala Asp Lys
50 55 60

Phe Ala Thr Arg Gln Tyr Lys Lys Glu Glu Phe Val Glu Thr Gln Ser
65 70 75 80

Leu Asp Asp Leu Ile Gln Glu Met Arg Glu Ala Val Glu Lys Ser Glu
85 90 95

Ala Ser Ser Glu Glu Val Pro Ser Ser Glu Asp Ile Leu Leu Pro Leu
100 105 110

Pro Leu Asp Asp Glu Glu Gln Gly Leu Asp Pro Leu Leu Leu Asp Asp
115 120 125

Glu Asn Pro Thr Glu Met Thr Glu Glu Val Glu Glu Glu Gln Asn Leu
130 135 140

Ser Arg Leu Asp Gln Glu Asp Ser Glu Lys Lys Ser Lys Lys Gly Phe
145 150 155 160

Ile Leu Thr Val Leu Ala Leu Val Ser Val Ile Ile Cys Val Ser Ala
165 170 175

Tyr Tyr Val Tyr Arg Gln Val Ala Arg Ser Thr Lys Glu Ile Glu Thr
180 185 190

Ser Gln Ser Thr Thr Ala Asn Gln Ser Asp Val Asp Asp Phe Asn Thr
195 200 205

Leu Tyr Asp Ala Phe Tyr Thr Asp Ser Asn Lys Thr Ala Leu Lys Asn
210 215 220

Ser Gln Phe Asp Lys Leu Ser Gln Leu Lys Thr Leu Leu Asp Lys Leu
225 230 235 240

Glu Gly Ser Arg Glu His Thr Leu Ala Lys Ser Lys Tyr Asp Ser Leu
245 250 255

Ala Thr Gln Ile Lys Ala Ile Gln Asp Val Asn Ala Gln Phe Glu Lys
260 265 270

Pro Ala Ile Val Asp Gly Val Leu Asp Thr Asn Ala Lys Ala Lys Ser
275 280 285

Asp Ala Lys Phe Thr Asp Ile Lys Thr Gly Asn Thr Glu Leu Asp Lys
290 295 300

Val Leu Asp Lys Ala Ile Ser Leu Gly Lys Ser Gln Gln Thr Ser Thr
305 310 315 320

Ser Ser Ser Ser Ser Ser Gln Thr Ser Ser Ser Ser Ser Ser Gln Ala
325 330 335

Ser Ser Asn Thr Thr Ser Glu Pro Lys Pro Ser Ser Ser Asn Glu Thr
340 345 350

Arg Ser Ser Arg Ser Glu Val Asn Met Gly Leu Ser Ser Ala Gly Val
355 360 365

Ala Val Gln Arg Ser Ala Ser Arg Val Ala Tyr Asn Gln Ser Ala Ile
370 375 380

Asp Asp Ser Asn Asn Ser Ala Trp Asp Phe Ala Asp Gly Val Leu Glu

385 390 395 400

Gln Ile Leu Ala Thr Ser Arg Ser Arg Gly Tyr Ile Thr Gly Asp Gln
405 410 415

Tyr Ile Leu Glu Arg Val Asn Ile Val Asn Gly Asn Gly Tyr Tyr Asn
420 425 430

Leu Tyr Lys Pro Asp Gly Thr Tyr Leu Phe Thr Leu Asn Cys Lys Thr
435 440 445

Gly Tyr Phe Val Gly Asn Gly Ala Gly His Ala Asp Asp Leu Asp Tyr
450 455 460

<210> 629
<211> 481
<212> PRT
<213> Streptococcus pneumoniae

<400> 629

Met Lys Gln Glu Glu Cys Gln Met Thr Lys Ala Asn Phe Gly Val Val
1 5 10 15

Gly Met Ala Val Met Gly Arg Asn Leu Ala Leu Asn Ile Glu Ser Arg
20 25 30

Gly Tyr Thr Val Ala Ile Tyr Asn Arg Ser Lys Glu Lys Thr Glu Asp
35 40 45

Val Ile Ala Cys His Pro Glu Lys Asn Phe Val Pro Ser Tyr Asp Val
50 55 60

Glu Ser Phe Val Asn Ser Ile Glu Lys Pro Arg Arg Ile Met Leu Met
65 70 75 80

Val Gln Ala Gly Pro Gly Thr Asp Ala Thr Ile Gln Ala Leu Leu Pro
85 90 95

His Leu Asp Lys Gly Asp Ile Leu Ile Asp Gly Gly Asn Thr Phe Tyr
100 105 110

Lys Asp Thr Ile Arg Arg Asn Glu Glu Leu Ala Asn Ser Gly Ile Asn

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        115                 120                 125

Phe Ile Gly Thr Gly Val Ser Gly Gly Glu Lys Gly Ala Leu Glu Gly
    130                 135                 140

Pro Ser Ile Met Pro Gly Gly Gln Lys Glu Ala Tyr Glu Leu Val Ala
145                 150                 155                 160

Asp Val Leu Glu Glu Ile Ser Ala Lys Ala Pro Glu Asp Gly Lys Pro
                165                 170                 175

Cys Val Thr Tyr Ile Gly Pro Asp Gly Ala Gly His Tyr Val Lys Met
            180                 185                 190

Val His Asn Gly Ile Glu Tyr Gly Asp Met Gln Leu Ile Ala Glu Ser
        195                 200                 205

Tyr Asp Leu Met Gln His Leu Leu Gly Leu Ser Ala Glu Asp Met Ala
    210                 215                 220

Glu Ile Phe Thr Glu Trp Asn Lys Gly Glu Leu Asp Ser Tyr Leu Ile
225                 230                 235                 240

Glu Ile Thr Ala Asp Ile Leu Ser Arg Lys Asp Asp Glu Gly Gln Asp
                245                 250                 255

Gly Pro Ile Val Asp Tyr Ile Leu Asp Ala Ala Gly Asn Lys Gly Thr
            260                 265                 270

Gly Lys Trp Thr Ser Gln Ser Ser Leu Asp Leu Gly Val Pro Leu Ser
        275                 280                 285

Leu Ile Thr Glu Ser Val Phe Ala Arg Tyr Ile Ser Thr Tyr Lys Glu
    290                 295                 300

Glu Arg Val His Ala Ser Lys Val Leu Pro Lys Pro Ala Ala Phe Asn
305                 310                 315                 320

Phe Glu Gly Asp Lys Ala Glu Leu Ile Glu Lys Ile Arg Gln Ala Leu
                325                 330                 335
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Tyr Phe Ser Lys Ile Ile Ser Tyr Ala Gln Gly Phe Ala Gln Leu Arg
340 345 350

Val Ala Ser Lys Glu Asn Asn Trp Asn Leu Pro Phe Ala Asp Ile Ala
355 360 365

Ser Ile Trp Arg Asp Gly Cys Ile Ile Arg Ser Arg Phe Leu Gln Lys
370 375 380

Ile Thr Asp Ala Tyr Asn Arg Asp Ala Asp Leu Ala Asn Leu Leu Leu
385 390 395 400

Asp Glu Tyr Phe Leu Asp Val Thr Ala Lys Tyr Gln Gln Ala Val Arg
405 410 415

Asp Ile Val Ala Leu Ala Val Gln Ala Gly Val Pro Val Pro Thr Phe
420 425 430

Ser Ala Ala Ile Thr Tyr Phe Asp Ser Tyr Arg Ser Ala Asp Leu Pro
435 440 445

Ala Asn Leu Ile Gln Ala Gln Arg Asp Tyr Phe Gly Ala His Thr Tyr
450 455 460

Gln Arg Lys Asp Lys Glu Gly Thr Phe His Tyr Ser Trp Tyr Asp Glu
465 470 475 480

Lys

<210> 630
<211> 144
<212> PRT
<213> Streptococcus pneumoniae

<400> 630

Met Asp Tyr Gln Arg Ile Asn Glu Tyr Leu Thr Ser Ile Phe Asn Asn
1 5 10 15

Val Leu Val Ile Glu Glu Val Asn Leu Arg Gly Ser Arg Phe Lys Asp
20 25 30

Ile Ser Ile Lys Glu Met His Thr Ile Asp Val Ile Gly Lys Ala Pro
35 40 45

Asp Val Thr Pro Ser Gln Val Ser Lys Glu Leu Met Val Thr Leu Gly
50 55 60

Thr Val Thr Thr Ser Leu Asn Asn Leu Glu Arg Lys Gly Tyr Ile Glu
65 70 75 80

Arg Val Arg Ser Glu Gln Asp Arg Arg Val Val His Leu His Leu Thr
85 90 95

Lys Lys Gly Arg Leu Ile His Arg Leu His Lys Arg Phe His Lys Ala
100 105 110

Met Val Glu Lys Ile Ile Asp Gly Met Ser Glu Glu Glu Ile Ala Val
115 120 125

Met Gly Lys Gly Leu Thr Asn Leu Tyr Gln Phe Leu Glu Asp Leu Lys
130 135 140

<210> 631
<211> 74
<212> PRT
<213> Streptococcus pneumoniae

<400> 631

Met Ala Val Phe Glu Lys Val Gln Glu Ile Ile Val Glu Glu Leu Gly
1 5 10 15

Lys Asp Ala Ser Glu Val Thr Leu Glu Ser Thr Phe Asp Asp Leu Asp
20 25 30

Ala Asp Ser Leu Asp Leu Phe Gln Val Ile Ser Glu Ile Glu Asp Ala
35 40 45

Phe Asp Ile Gln Ile Glu Ala Glu Asn Asp Leu Lys Thr Val Gly Asp
50 55 60

Leu Val Ala Tyr Val Glu Glu Gln Ala Lys
65 70

<210> 632
<211> 774
<212> PRT
<213> Streptococcus pneumoniae

<400> 632

Met Val Val Lys Thr Val Val Glu Ala Gln Asp Ile Phe Asp Lys Ala
1 5 10 15

Trp Glu Gly Phe Lys Gly Val Asp Trp Lys Glu Lys Ala Ser Val Ser
20 25 30

Arg Phe Val Gln Ala Asn Tyr Thr Pro Tyr Asp Gly Asp Glu Ser Phe
35 40 45

Leu Ala Gly Pro Thr Glu Arg Ser Leu His Ile Lys Lys Ile Val Glu
50 55 60

Glu Thr Lys Ala His Tyr Glu Glu Thr Arg Phe Pro Met Asp Thr Arg
65 70 75 80

Pro Thr Ser Ile Ala Asp Ile Pro Ala Gly Phe Ile Asp Lys Glu Asn
85 90 95

Glu Val Ile Phe Gly Ile Gln Asn Asp Glu Leu Phe Lys Leu Asn Phe
100 105 110

Met Pro Lys Gly Gly Ile Arg Met Ala Glu Thr Thr Leu Lys Glu Asn
115 120 125

Gly Tyr Glu Pro Asp Pro Ala Val His Glu Ile Phe Thr Lys Tyr Val
130 135 140

Thr Thr Val Asn Asp Gly Ile Phe Arg Ala Tyr Thr Ser Asn Ile Arg
145 150 155 160

Arg Ala Arg His Ala His Thr Val Thr Gly Leu Pro Asp Ala Tyr Ser
165 170 175

Arg Gly Arg Ile Ile Gly Val Tyr Ala Arg Leu Ala Leu Tyr Gly Ala
180 185 190

Asp Tyr Leu Met Gln Glu Lys Val Asn Asp Trp Asn Ala Ile Lys Glu
195 200 205

Ile Asp Glu Glu Thr Ile Arg Leu Arg Glu Glu Val Asn Leu Gln Tyr
210 215 220

Gln Ala Leu Gln Gln Val Val Arg Leu Gly Asp Leu Tyr Gly Val Asp
225 230 235 240

Val Arg Lys Pro Ala Met Asn Val Lys Glu Ala Ile Gln Trp Val Asn
245 250 255

Ile Ala Phe Met Ala Val Cys Arg Val Ile Asn Gly Ala Ala Thr Ser
260 265 270

Leu Gly Arg Val Pro Ile Val Leu Asp Ile Phe Ala Glu Arg Asp Leu
275 280 285

Ala Arg Gly Thr Phe Thr Glu Ser Glu Ile Gln Glu Phe Val Asp Asp
290 295 300

Phe Val Met Lys Leu Arg Thr Val Lys Phe Ala Arg Thr Lys Ala Tyr
305 310 315 320

Asp Gln Leu Tyr Ser Gly Asp Pro Thr Phe Ile Thr Thr Ser Met Ala
325 330 335

Gly Met Gly Asn Asp Gly Arg His Arg Val Thr Lys Met Asp Tyr Arg
340 345 350

Phe Leu Asn Thr Leu Asp Asn Ile Gly Asn Ser Pro Glu Pro Asn Leu
355 360 365

Thr Val Leu Trp Thr Asp Lys Leu Pro Tyr Asn Phe Arg Arg Tyr Cys
370 375 380

Met His Met Ser His Lys His Ser Ser Ile Gln Tyr Glu Gly Val Thr
385 390 395 400

Thr Met Ala Lys Asp Gly Tyr Gly Glu Met Ser Cys Ile Ser Cys Cys
405 410 415

Val Ser Pro Leu Asp Pro Glu Asn Glu Glu Gln Arg His Asn Ile Gln
420 425 430

Tyr Phe Gly Ala Arg Val Asn Val Leu Lys Ala Leu Leu Thr Gly Leu
435 440 445

Asn Gly Gly Tyr Asp Asp Val His Lys Asp Tyr Lys Val Phe Asp Ile
450 455 460

Glu Pro Ile Arg Asp Glu Val Leu Glu Phe Glu Ser Val Lys Ala Asn
465 470 475 480

Phe Glu Lys Ser Leu Asp Trp Leu Thr Asp Thr Tyr Val Asp Ala Leu
485 490 495

Asn Ile Ile His Tyr Met Thr Asp Arg Tyr Asn Tyr Glu Ala Val Gln
500 505 510

Met Ala Phe Leu Pro Thr Lys Gln Arg Ala Asn Met Gly Phe Gly Ile
515 520 525

Cys Gly Phe Ala Asn Thr Val Asp Thr Leu Ser Ala Ile Lys Tyr Ala
530 535 540

Thr Val Lys Pro Ile Arg Asp Glu Asp Gly Tyr Ile Tyr Asp Tyr Glu
545 550 555 560

Thr Ile Gly Asp Tyr Pro Arg Trp Gly Glu Asp Asp Pro Arg Ser Asn
565 570 575

Glu Leu Ala Glu Trp Leu Ile Glu Ala Tyr Thr Thr Arg Leu Arg Ser
580 585 590

His Lys Leu Tyr Lys Asp Ala Glu Ala Thr Val Ser Leu Leu Thr Ile
595 600 605

Thr Ser Asn Val Ala Tyr Ser Lys Gln Thr Gly Asn Ser Pro Val His
610 615 620

Lys Gly Val Tyr Leu Asn Glu Asp Gly Ser Val Asn Leu Ser Lys Leu
625 630 635 640

Glu Phe Phe Ser Pro Gly Ala Asn Pro Ser Asn Lys Ala Lys Gly Gly
645 650 655

Trp Leu Gln Asn Leu Asn Ser Leu Ser Ser Leu Asp Phe Ser Tyr Ala
660 665 670

Ala Asp Gly Ile Ser Leu Thr Thr Gln Val Ser Pro Arg Ala Leu Gly
675 680 685

Lys Thr Arg Asp Glu Gln Val Asp Asn Leu Val Thr Ile Leu Asp Gly
690 695 700

Tyr Phe Glu Asn Gly Gly Gln His Val Asn Leu Asn Val Met Asp Leu
705 710 715 720

Asn Asp Val Tyr Glu Lys Ile Met Ser Gly Glu Asp Val Ile Val Arg
725 730 735

Ile Ser Gly Tyr Cys Val Asn Thr Lys Tyr Leu Thr Pro Glu Gln Lys
740 745 750

Thr Glu Leu Thr Gln Arg Val Phe His Glu Val Leu Ser Met Asp Asp
755 760 765

Ala Leu Asp Ala Leu Ser
770

<210> 633
<211> 535
<212> PRT
<213> Streptococcus pneumoniae

<400> 633

Met Ser Thr Lys Tyr Ile Phe Val Thr Gly Gly Val Val Ser Ser Ile
1 5 10 15

Gly Lys Gly Ile Val Ala Ala Ser Leu Gly Arg Leu Leu Lys Asn Arg
20 25 30

Gly Leu Lys Val Thr Ile Gln Lys Phe Asp Pro Tyr Ile Asn Ile Asp
35 40 45

Pro Gly Thr Met Ser Pro Tyr Gln His Gly Glu Val Phe Val Thr Asp
50 55 60

Asp Gly Ala Glu Thr Asp Leu Asp Leu Gly His Tyr Glu Arg Phe Ile
65 70 75 80

Asp Ile Asn Leu Asn Lys Tyr Ser Asn Val Thr Thr Gly Lys Ile Tyr
85 90 95

Ser Glu Val Leu Arg Lys Glu Arg Arg Gly Glu Tyr Leu Gly Ala Thr
100 105 110

Val Gln Val Ile Pro His Ile Thr Asp Ala Leu Lys Glu Lys Ile Lys
115 120 125

Arg Ala Ala Leu Thr Thr Asp Ser Asp Val Ile Ile Thr Glu Val Gly
130 135 140

Gly Thr Val Gly Asp Ile Glu Ser Leu Pro Phe Leu Glu Ala Leu Arg
145 150 155 160

Gln Met Lys Ala Asp Val Gly Ala Asp Asn Val Met Tyr Ile His Thr
165 170 175

Thr Leu Leu Pro Tyr Leu Lys Ala Ala Gly Glu Met Lys Thr Lys Pro
180 185 190

Thr Gln His Ser Val Lys Glu Leu Arg Gly Leu Gly Ile Gln Pro Asn
195 200 205

Met Leu Val Ile Arg Thr Glu Glu Pro Ala Gly Gln Gly Ile Lys Asn
210 215 220

Lys Leu Ala Gln Phe Cys Asp Val Ala Pro Glu Ala Val Ile Glu Ser
225 230 235 240

Leu Asp Val Glu His Leu Tyr Gln Ile Pro Leu Asn Leu Gln Ala Gln
245 250 255

Gly Met Asp Gln Ile Val Cys Asp His Leu Lys Leu Asp Ala Pro Ala

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            260                 265                 270

Ala Asp Met Thr Glu Trp Ser Ala Met Val Asp Lys Val Met Asn Leu
        275                 280                 285

Lys Lys Gln Val Lys Ile Ser Leu Val Gly Lys Tyr Val Glu Leu Gln
    290                 295                 300

Asp Ala Tyr Ile Ser Val Val Glu Ala Leu Lys His Ser Gly Tyr Val
305                 310                 315                 320

Asn Asp Ala Glu Val Lys Ile Asn Trp Val Asn Ala Asn Asp Val Thr
                325                 330                 335

Ala Glu Asn Val Ala Glu Leu Leu Ser Asp Ala Asp Gly Ile Ile Val
            340                 345                 350

Pro Gly Gly Phe Gly Gln Arg Gly Thr Glu Gly Lys Ile Gln Ala Ile
        355                 360                 365

Arg Tyr Ala Arg Glu Asn Asp Val Pro Met Leu Gly Val Cys Leu Gly
    370                 375                 380

Met Gln Leu Thr Cys Ile Glu Phe Ala Arg His Val Leu Gly Leu Glu
385                 390                 395                 400

Gly Ala Asn Ser Ala Glu Leu Ala Pro Glu Thr Lys Tyr Pro Ile Ile
                405                 410                 415

Asp Ile Met Arg Asp Gln Ile Asp Ile Glu Asp Met Gly Gly Thr Leu
            420                 425                 430

Arg Leu Gly Leu Tyr Pro Ser Lys Leu Lys Arg Gly Ser Lys Ala Ala
        435                 440                 445

Ala Ala Tyr His Asn Gln Glu Val Val Gln Arg Arg His Arg His Arg
    450                 455                 460

Tyr Glu Phe Asn Asn Ala Phe Arg Glu Gln Phe Glu Ala Ala Gly Phe
465                 470                 475                 480
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Val Phe Ser Gly Val Ser Pro Asp Asn Arg Leu Val Glu Ile Val Glu
                485                 490                 495

Ile Pro Glu Asn Lys Phe Phe Val Ala Cys Gln Tyr His Pro Glu Leu
            500                 505                 510

Ser Ser Arg Pro Asn Arg Pro Glu Glu Leu Tyr Thr Ala Phe Val Thr
        515                 520                 525

Ala Ala Val Glu Asn Ser Asn
    530                 535
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<210>  634
<211>  378
<212>  PRT
<213>  Streptococcus pneumoniae

<400>  634

Met Asn Asn Thr Glu Phe Tyr Asp Arg Leu Gly Val Ser Lys Asn Ala
1               5                   10                  15

Ser Ala Asp Glu Ile Lys Lys Ala Tyr Arg Lys Leu Ser Lys Lys Tyr
            20                  25                  30

His Pro Asp Ile Asn Lys Glu Pro Gly Ala Glu Asp Lys Tyr Lys Glu
        35                  40                  45

Val Gln Glu Ala Tyr Glu Thr Leu Ser Asp Asp Gln Lys Arg Ala Ala
    50                  55                  60

Tyr Asp Gln Tyr Gly Ala Ala Gly Ala Asn Gly Gly Phe Gly Gly Ala
65                  70                  75                  80

Gly Gly Phe Gly Gly Phe Asn Gly Ala Gly Gly Phe Gly Gly Phe Glu
                85                  90                  95

Asp Ile Phe Ser Ser Phe Phe Gly Gly Gly Gly Ser Ser Arg Asn Pro
            100                 105                 110

Asn Ala Pro Arg Gln Gly Asp Asp Leu Gln Tyr Arg Val Asn Leu Thr
        115                 120                 125
```

Phe Glu Glu Ala Ile Phe Gly Thr Glu Lys Glu Val Lys Tyr His Arg
    130   135   140

Glu Ala Gly Cys Arg Thr Cys Asn Gly Ser Gly Ala Lys Pro Gly Thr
145   150   155   160

Ser Pro Val Thr Cys Gly Arg Cys His Gly Ala Gly Val Ile Asn Val
                165   170   175

Asp Thr Gln Thr Pro Leu Gly Met Met Arg Arg Gln Val Thr Cys Asp
            180   185   190

Val Cys His Gly Arg Gly Lys Glu Ile Lys Tyr Pro Cys Thr Thr Cys
        195   200   205

His Gly Thr Gly His Glu Lys Gln Ala His Ser Val His Val Lys Ile
    210   215   220

Pro Ala Gly Val Glu Thr Gly Gln Gln Ile Arg Leu Ala Gly Gln Gly
225   230   235   240

Glu Ala Gly Phe Asn Gly Gly Pro Tyr Gly Asp Leu Tyr Val Val Val
                245   250   255

Ser Val Glu Ala Ser Asp Lys Phe Glu Arg Glu Gly Thr Thr Ile Phe
            260   265   270

Tyr Asn Leu Asn Leu Asn Phe Val Gln Ala Ala Leu Gly Asp Thr Val
        275   280   285

Asp Ile Pro Thr Val His Gly Asp Val Glu Leu Val Ile Pro Glu Gly
    290   295   300

Thr Gln Thr Gly Lys Lys Phe Arg Leu Arg Ser Lys Gly Ala Pro Ser
305   310   315   320

Leu Arg Gly Gly Ala Val Gly Asp Gln Tyr Val Thr Val Asn Val Val
                325   330   335

Thr Pro Thr Gly Leu Asn Asp Arg Gln Lys Val Ala Leu Lys Glu Phe
            340   345   350

Ala Ala Ala Gly Asp Leu Lys Val Asn Pro Lys Lys Lys Gly Phe Phe
355 360 365

Asp His Ile Lys Asp Ala Phe Asp Gly Glu
370 375

<210> 635
<211> 95
<212> PRT
<213> Streptococcus pneumoniae

<400> 635

Met Lys Leu Ser Asn Leu Leu Leu Phe Ala Gly Ala Ala Ala Gly Ser
1 5 10 15

Tyr Leu Val Thr Lys Asn Arg Gln Thr Ile Thr Asp Glu Val Leu Asn
20 25 30

Thr Thr Asp Arg Val Gln Ala Ile Lys Asp Asp Val Asp Ile Ile Gln
35 40 45

Asn Ser Leu Gln Ile Ile Asn Gln Gln Lys Glu Leu Ile Lys Glu Tyr
50 55 60

Gln Glu Asp Leu Thr Tyr Lys Phe Lys Val Leu Glu Lys Asp Ile Gln
65 70 75 80

Thr Arg Leu Ala Val Ile Lys Glu Met Gln Gly Thr Glu Asp Lys
85 90 95

<210> 636
<211> 378
<212> PRT
<213> Streptococcus pneumoniae

<400> 636

Met Ser Lys Glu Met Leu Glu Ala Phe Arg Ile Leu Glu Glu Asp Lys
1 5 10 15

Gly Ile Lys Lys Glu Asp Ile Ile Asp Ala Val Val Glu Ser Leu Arg
20 25 30

Ser Ala Tyr Arg Arg Arg Tyr Gly Gln Ser Asp Ser Val Ala Ile Asp
35 40 45

Phe Asn Glu Lys Thr Gly Asp Phe Thr Val Tyr Thr Val Arg Glu Val
50 55 60

Val Asp Glu Val Phe Asp Ser Arg Leu Glu Ile Ser Leu Lys Asp Ala
65 70 75 80

Leu Ala Ile Asn Ser Ala Tyr Glu Leu Gly Asp Lys Ile Lys Phe Glu
85 90 95

Glu Ala Pro Ala Glu Phe Gly Arg Val Ala Ala Gln Ser Ala Lys Gln
100 105 110

Thr Ile Met Glu Lys Met Arg Lys Gln Thr Arg Ala Ile Thr Tyr Asn
115 120 125

Thr Tyr Lys Glu His Glu Gln Glu Ile Met Ser Gly Thr Val Glu Arg
130 135 140

Phe Asp Asn Arg Phe Ile Tyr Val Asn Leu Gly Ser Ile Glu Ala Gln
145 150 155 160

Leu Ser Lys Gln Asp Gln Ile Pro Gly Glu Val Phe Ala Ser His Asp
165 170 175

Arg Ile Glu Val Tyr Val Tyr Lys Val Glu Asp Asn Pro Arg Gly Val
180 185 190

Asn Val Phe Val Ser Arg Ser His Pro Glu Met Ile Lys Arg Leu Met
195 200 205

Glu Gln Glu Ile Pro Glu Val Tyr Asp Gly Thr Val Glu Ile Met Ser
210 215 220

Val Ala Arg Glu Ala Gly Asp Arg Thr Lys Val Ala Val Arg Ser His
225 230 235 240

Asn Pro Asn Val Asp Ala Ile Gly Thr Ile Val Gly Arg Gly Gly Ala
245 250 255

Asn Ile Lys Lys Ile Thr Ser Lys Phe His Pro Ala Arg Tyr Asp Ala
260 265 270

Lys Asn Asp Arg Met Val Pro Ile Glu Glu Asn Ile Asp Val Ile Glu
275 280 285

Trp Val Ala Asp Pro Ala Glu Phe Ile Tyr Asn Ala Ile Ala Pro Ala
290 295 300

Glu Val Asp Gln Val Ile Phe Asp Glu Asn Asp Ser Lys Arg Ala Leu
305 310 315 320

Val Val Val Pro Asp Asn Lys Leu Ser Leu Ala Ile Gly Arg Arg Gly
325 330 335

Gln Asn Val Arg Leu Ala Ala His Leu Thr Gly Tyr Arg Ile Asp Ile
340 345 350

Lys Ser Ala Ser Glu Phe Glu Ala Met Glu Asp Ala Ala Ser Val Glu
355 360 365

Leu Glu Val Glu Asn Asp Thr Val Glu Glu
370 375

<210> 637
<211> 958
<212> PRT
<213> Streptococcus pneumoniae

<400> 637

Met Ser Lys Lys Arg Leu Tyr Glu Ile Ala Lys Glu Leu Gly Lys Glu
1 5 10 15

Ser Lys Glu Val Val Ala Arg Ala Lys Glu Leu Gly Leu Asp Val Lys
20 25 30

Ser His Ser Ser Ser Val Glu Glu Ala Val Ala Ala Lys Ile Ala Ala
35 40 45

Ser Phe Lys Pro Ala Ala Ala Pro Lys Val Glu Ala Lys Pro Ala Ala
50 55 60

Pro Lys Val Ser Ala Glu Lys Lys Ala Glu Lys Ser Glu Pro Ala Lys
65 70 75 80

Pro Ala Val Ala Lys Glu Glu Ala Lys Pro Ala Ala Pro Lys Ala Ser
85 90 95

Ala Glu Lys Lys Ala Glu Lys Ser Glu Pro Val Lys Pro Ala Val Ala
100 105 110

Lys Glu Glu Ala Lys Pro Ala Glu Pro Val Thr Pro Lys Thr Glu Lys
115 120 125

Val Ala Ala Lys Pro Gln Ser Arg Asn Phe Lys Ala Glu Arg Glu Ala
130 135 140

Arg Ala Lys Glu Gln Ala Glu Arg Arg Lys Gln Asn Lys Gly Asn Asn
145 150 155 160

Arg Asp Gln Gln Gln Asn Gly Asn Arg Gln Lys Asn Asp Gly Arg Asn
165 170 175

Gly Gly Lys Gln Gly Gln Ser Asn Arg Asp Asn Arg Arg Phe Asn Asp
180 185 190

Gln Ala Lys Lys Gln Gln Gly Gln Gln Lys Arg Arg Asn Glu Arg Arg
195 200 205

Gln Gln Glu Asp Lys Arg Ser Asn Gln Ala Ala Pro Arg Ile Asp Phe
210 215 220

Lys Ala Arg Ala Ala Ala Leu Lys Ala Glu Gln Asn Ala Glu Tyr Ala
225 230 235 240

Arg Ser Ser Glu Glu Arg Phe Lys Gln Tyr Gln Ala Ala Lys Glu Ala
245 250 255

Leu Ala Gln Ala Asn Lys Arg Lys Glu Pro Glu Glu Ile Phe Glu Glu
260 265 270

Ala Ala Lys Leu Ala Glu Gln Ala Gln Gln Val Gln Ala Val Val Glu
275 280 285

Val Val Pro Glu Lys Lys Glu Pro Ala Val Asp Thr Arg Arg Lys Lys
290 295 300

Gln Ala Arg Pro Asp Lys Asn Arg Asp Asp Tyr Asp His Glu Glu Asp
305 310 315 320

Gly Pro Arg Lys Gln Gln Lys Asn Arg Ser Ser Gln Asn Gln Val Arg
325 330 335

Asn Gln Lys Asn Ser Asn Trp Asn Asn Asn Lys Lys Asn Lys Lys Gly
340 345 350

Asn Asn Lys Asn Asn Arg Asn Gln Thr Pro Lys Pro Val Thr Glu Arg
355 360 365

Lys Phe His Glu Leu Pro Thr Glu Phe Glu Tyr Thr Asp Gly Met Thr
370 375 380

Val Ala Glu Ile Ala Lys Arg Ile Lys Arg Glu Pro Ala Glu Ile Val
385 390 395 400

Lys Lys Leu Phe Met Met Gly Val Met Ala Thr Gln Asn Gln Ser Leu
405 410 415

Asp Gly Glu Thr Ile Glu Leu Leu Met Val Asp Tyr Gly Ile Glu Ala
420 425 430

Lys Gln Lys Val Glu Val Asp Asn Ala Asp Ile Glu Arg Phe Phe Val
435 440 445

Glu Asp Gly Tyr Leu Asn Glu Asp Glu Leu Val Glu Arg Pro Pro Val
450 455 460

Val Thr Ile Met Gly His Val Asp His Gly Lys Thr Thr Leu Leu Asp
465 470 475 480

Thr Leu Arg Asn Ser Arg Val Ala Thr Gly Glu Ala Gly Gly Ile Thr
485 490 495

Gln His Ile Gly Ala Tyr Gln Ile Val Glu Asn Gly Lys Lys Ile Thr

500 505 510

Phe Leu Asp Thr Pro Gly His Ala Ala Phe Thr Ser Met Arg Ala Arg
515 520 525

Gly Ala Ser Val Thr Asp Ile Thr Ile Leu Val Val Ala Ala Asp Asp
530 535 540

Gly Val Met Pro Gln Thr Ile Glu Ala Ile Asn His Ser Lys Ala Ala
545 550 555 560

Asn Val Pro Ile Ile Val Ala Ile Asn Lys Ile Asp Lys Pro Gly Ala
565 570 575

Asn Pro Glu Arg Val Ile Gly Glu Leu Ala Glu His Gly Val Met Ser
580 585 590

Thr Ala Trp Gly Gly Asp Ser Glu Phe Val Glu Ile Ser Ala Lys Phe
595 600 605

Asn Gln Asn Ile Glu Glu Leu Leu Glu Thr Val Leu Leu Val Ala Glu
610 615 620

Ile Gln Glu Leu Lys Ala Asp Pro Thr Val Arg Ala Ile Gly Thr Val
625 630 635 640

Ile Glu Ala Arg Leu Asp Lys Gly Lys Gly Ala Val Ala Thr Leu Leu
645 650 655

Val Gln Gln Gly Thr Leu Asn Val Gln Asp Pro Ile Val Val Gly Asn
660 665 670

Thr Phe Gly Arg Val Arg Ala Met Thr Asn Asp Leu Gly Arg Arg Val
675 680 685

Lys Val Ala Gly Pro Ser Thr Pro Val Ser Ile Thr Gly Leu Asn Glu
690 695 700

Ala Pro Met Ala Gly Asp His Phe Ala Val Tyr Glu Asp Glu Lys Ser
705 710 715 720

Ala Arg Ala Ala Gly Glu Glu Arg Ala Lys Arg Ala Leu Met Lys Gln
725 730 735

Arg Gln Ala Thr Gln Arg Val Ser Leu Glu Asn Leu Phe Asp Thr Leu
740 745 750

Lys Ala Gly Glu Leu Lys Ser Val Asn Val Ile Ile Lys Ala Asp Val
755 760 765

Gln Gly Ser Val Glu Ala Leu Ser Ala Ser Leu Gln Lys Ile Asp Val
770 775 780

Glu Gly Val Lys Val Thr Ile Val His Ser Ala Val Gly Ala Ile Asn
785 790 795 800

Glu Ser Asp Val Thr Leu Ala Glu Ala Ser Asn Ala Phe Ile Val Gly
805 810 815

Phe Asn Val Arg Pro Thr Pro Gln Ala Arg Gln Gln Ala Glu Ala Asp
820 825 830

Asp Val Glu Ile Arg Leu His Ser Ile Ile Tyr Lys Val Ile Glu Glu
835 840 845

Met Glu Glu Ala Met Lys Gly Met Leu Asp Pro Glu Phe Glu Glu Lys
850 855 860

Val Ile Gly Glu Ala Val Ile Arg Glu Thr Phe Lys Val Ser Lys Val
865 870 875 880

Gly Thr Ile Gly Gly Phe Met Val Ile Asn Gly Lys Val Ala Arg Asp
885 890 895

Ser Lys Val Arg Val Ile Arg Asp Gly Val Val Ile Tyr Asp Gly Glu
900 905 910

Leu Ala Ser Leu Lys His Tyr Lys Asp Asp Val Lys Glu Val Thr Asn
915 920 925

Gly Arg Glu Gly Gly Leu Met Ile Asp Gly Tyr Asn Asp Ile Lys Met
930 935 940

Asp Asp Val Ile Glu Ala Tyr Val Met Glu Glu Ile Lys Arg
945 950 955

<210> 638
<211> 293
<212> PRT
<213> Streptococcus pneumoniae

<400> 638

Met Ala Ile Val Ser Ala Glu Lys Phe Val Gln Ala Ala Arg Asp Asn
1 5 10 15

Gly Tyr Ala Val Gly Gly Phe Asn Thr Asn Asn Leu Glu Trp Thr Gln
20 25 30

Ala Ile Leu Arg Ala Ala Glu Ala Lys Lys Ala Pro Val Leu Ile Gln
35 40 45

Thr Ser Met Gly Ala Ala Lys Tyr Met Gly Gly Tyr Lys Val Ala Arg
50 55 60

Asn Leu Ile Ala Asn Leu Val Glu Ser Met Gly Ile Thr Val Pro Val
65 70 75 80

Ala Ile His Leu Asp His Gly His Tyr Glu Asp Ala Leu Glu Cys Ile
85 90 95

Glu Val Gly Tyr Thr Ser Ile Met Phe Asp Gly Ser His Leu Pro Val
100 105 110

Glu Glu Asn Leu Lys Leu Ala Lys Glu Val Val Glu Lys Ala His Ala
115 120 125

Lys Gly Ile Ser Val Glu Ala Glu Val Gly Thr Ile Gly Gly Glu Glu
130 135 140

Asp Gly Ile Ile Gly Lys Gly Glu Leu Ala Pro Ile Glu Asp Ala Lys
145 150 155 160

Ala Met Val Glu Thr Gly Ile Asp Phe Leu Ala Ala Gly Ile Gly Asn
165 170 175

Ile His Gly Pro Tyr Pro Val Asn Trp Glu Gly Leu Asp Leu Asp His
180 185 190

Leu Gln Lys Leu Thr Glu Ala Leu Pro Gly Phe Pro Ile Val Leu His
195 200 205

Gly Gly Ser Gly Ile Pro Asp Glu Gln Ile Gln Ala Ala Ile Lys Leu
210 215 220

Gly Val Ala Lys Val Asn Val Asn Thr Glu Cys Gln Ile Ala Phe Ala
225 230 235 240

Asn Ala Thr Arg Lys Phe Ala Arg Asp Tyr Glu Ala Asn Glu Ala Glu
245 250 255

Tyr Asp Lys Lys Lys Leu Phe Asp Pro Arg Lys Phe Leu Ala Asp Gly
260 265 270

Val Lys Ala Ile Gln Ala Ser Val Glu Glu Arg Ile Asp Val Phe Gly
275 280 285

Ser Glu Gly Lys Ala
290

<210> 639
<211> 141
<212> PRT
<213> Streptococcus pneumoniae

<400> 639

Met Ala Lys Lys Val Glu Lys Leu Val Lys Leu Gln Ile Pro Ala Gly
1 5 10 15

Lys Ala Thr Pro Ala Pro Pro Val Gly Pro Ala Leu Gly Gln Ala Gly
20 25 30

Ile Asn Ile Met Gly Phe Thr Lys Glu Phe Asn Ala Arg Thr Ala Asp
35 40 45

Gln Ala Gly Met Ile Ile Pro Val Val Ile Ser Val Tyr Glu Asp Lys
50 55 60

Ser Phe Thr Phe Val Thr Lys Thr Pro Pro Ala Ala Val Leu Leu Lys
65 70 75 80

Lys Ala Ala Gly Val Glu Lys Gly Ser Gly Thr Pro Asn Lys Thr Lys
85 90 95

Val Ala Thr Val Thr Arg Ala Gln Val Gln Glu Ile Ala Glu Thr Lys
100 105 110

Met Pro Asp Leu Asn Ala Ala Asn Val Glu Ser Ala Met Arg Met Ile
115 120 125

Glu Gly Thr Ala Arg Ser Met Gly Phe Thr Val Val Asp
130 135 140

<210> 640
<211> 229
<212> PRT
<213> Streptococcus pneumoniae

<400> 640

Met Ala Lys Lys Ser Lys Gln Leu Arg Ala Ala Leu Glu Lys Ile Asp
1 5 10 15

Ser Thr Lys Ala Tyr Ser Val Glu Glu Ala Val Ala Leu Ala Lys Glu
20 25 30

Thr Asn Phe Ala Lys Phe Asp Ala Thr Val Glu Val Ala Tyr Asn Leu
35 40 45

Asn Ile Asp Val Lys Lys Ala Asp Gln Gln Ile Arg Gly Ala Met Val
50 55 60

Leu Pro Asn Gly Thr Gly Lys Thr Ser Arg Val Leu Val Phe Ala Arg
65 70 75 80

Gly Ala Lys Ala Glu Glu Ala Lys Ala Ala Gly Ala Asp Phe Val Gly
85 90 95

Glu Asp Asp Leu Val Ala Lys Ile Asn Asp Gly Trp Leu Asp Phe Asp
100 105 110

Val Val Ile Ala Thr Pro Asp Met Met Ala Leu Val Gly Arg Leu Gly
115 120 125

Arg Val Leu Gly Pro Arg Asn Leu Met Pro Asn Pro Lys Thr Gly Thr
130 135 140

Val Thr Met Asp Val Ala Lys Ala Val Glu Glu Ser Lys Gly Gly Lys
145 150 155 160

Ile Thr Tyr Arg Ala Asp Arg Ala Gly Asn Val Gln Ala Ile Ile Gly
165 170 175

Lys Val Ser Phe Glu Ala Glu Lys Leu Val Glu Asn Phe Lys Ala Phe
180 185 190

Asn Glu Thr Ile Gln Lys Ala Lys Pro Ala Thr Ala Lys Gly Thr Tyr
195 200 205

Val Thr Asn Leu Thr Ile Thr Thr Thr Gln Gly Val Gly Ile Lys Val
210 215 220

Asp Val Asn Ser Leu
225

<210> 641
<211> 620
<212> PRT
<213> Streptococcus pneumoniae

<400> 641

Met Asn Ile Ile Glu Glu Ile Met Thr Lys Leu Arg Glu Asp Ile Arg
1 5 10 15

Asn Ile Ala Ile Ile Ala His Val Asp His Gly Lys Thr Thr Leu Val
20 25 30

Asp Glu Leu Leu Lys Gln Ser Glu Thr Leu Asp Ala Arg Thr Glu Leu
35 40 45

Ala Glu Arg Ala Met Asp Ser Asn Asp Ile Glu Lys Glu Arg Gly Ile
50 55 60

```
Thr Ile Leu Ala Lys Asn Thr Ala Val Ala Tyr Asn Gly Thr Arg Ile
65                  70                  75                  80

Asn Ile Met Asp Thr Pro Gly His Ala Asp Phe Gly Gly Glu Val Glu
                85                  90                  95

Arg Ile Met Lys Met Val Asp Gly Val Val Leu Val Val Asp Ala Tyr
            100                 105                 110

Glu Gly Thr Met Pro Gln Thr Arg Phe Val Leu Lys Lys Ala Leu Glu
        115                 120                 125

Gln Asp Leu Val Pro Ile Val Val Val Asn Lys Ile Asp Lys Pro Ser
    130                 135                 140

Ala Arg Pro Ala Glu Val Val Asp Glu Val Leu Glu Leu Phe Ile Glu
145                 150                 155                 160

Leu Gly Ala Asp Asp Asp Gln Leu Asp Phe Pro Val Val Tyr Ala Ser
                165                 170                 175

Ala Ile Asn Gly Thr Ser Ser Leu Ser Asp Asp Pro Ala Asp Gln Glu
            180                 185                 190

Ala Thr Met Ala Pro Ile Phe Asp Thr Ile Ile Asp His Ile Pro Ala
        195                 200                 205

Pro Val Asp Asn Ser Asp Glu Pro Leu Gln Phe Gln Val Ser Leu Leu
    210                 215                 220

Asp Tyr Asn Asp Phe Val Gly Arg Ile Gly Ile Gly Arg Val Phe Arg
225                 230                 235                 240

Gly Thr Val Lys Val Gly Asp Gln Val Thr Leu Ser Lys Leu Asp Gly
                245                 250                 255

Thr Thr Lys Asn Phe Arg Val Thr Lys Leu Phe Gly Phe Phe Gly Leu
            260                 265                 270

Glu Arg Arg Glu Ile Gln Glu Ala Lys Ala Gly Asp Leu Ile Ala Val
        275                 280                 285
```

Ser Gly Met Glu Asp Ile Phe Val Gly Glu Thr Ile Thr Pro Thr Asp
290 295 300

Ala Val Glu Ala Leu Pro Ile Leu His Ile Asp Glu Pro Thr Leu Gln
305 310 315 320

Met Thr Phe Leu Val Asn Asn Ser Pro Phe Ala Gly Lys Glu Gly Lys
325 330 335

Trp Val Thr Ser Arg Lys Val Glu Glu Arg Leu Gln Ala Glu Leu Gln
340 345 350

Thr Asp Val Ser Leu Arg Val Asp Pro Thr Asp Ser Pro Asp Lys Trp
355 360 365

Thr Val Ser Gly Arg Gly Glu Leu His Leu Ser Ile Leu Ile Glu Thr
370 375 380

Met Arg Arg Glu Gly Tyr Glu Leu Gln Val Ser Arg Pro Glu Val Ile
385 390 395 400

Val Lys Glu Ile Asp Gly Ile Lys Cys Glu Pro Phe Glu Arg Val Gln
405 410 415

Ile Asp Thr Pro Glu Glu Tyr Gln Gly Ser Val Ile Gln Ser Leu Ser
420 425 430

Glu Arg Lys Gly Glu Met Leu Asp Met Ile Ser Thr Gly Asn Gly Gln
435 440 445

Thr Arg Leu Val Phe Leu Val Pro Ala Arg Gly Leu Ile Gly Tyr Ser
450 455 460

Thr Glu Phe Leu Ser Met Thr Arg Gly Tyr Gly Ile Met Asn His Thr
465 470 475 480

Phe Asp Gln Tyr Leu Pro Leu Ile Pro Gly Glu Ile Gly Gly Arg His
485 490 495

Arg Gly Ala Leu Val Ser Ile Asp Ala Gly Lys Ala Thr Thr Tyr Ser

500 505 510

Ile Met Ser Ile Glu Glu Arg Gly Thr Ile Phe Val Asn Pro Gly Thr
515 520 525

Glu Val Tyr Glu Gly Met Ile Ile Gly Glu Asn Ser Arg Glu Asn Asp
530 535 540

Leu Thr Val Asn Ile Thr Lys Ala Lys Gln Met Thr Asn Val Arg Ser
545 550 555 560

Ala Thr Lys Asp Gln Thr Ala Val Ile Lys Thr Pro Arg Ile Leu Thr
565 570 575

Leu Glu Glu Ser Leu Glu Phe Leu Asn Asp Asp Glu Tyr Met Glu Val
580 585 590

Thr Pro Glu Ser Ile Arg Leu Arg Lys Gln Ile Leu Asn Lys Ala Glu
595 600 605

Arg Glu Lys Ala Asn Lys Lys Lys Lys Ser Ala Glu
610 615 620

<210> 642
<211> 378
<212> PRT
<213> Streptococcus pneumoniae

<400> 642

Met Ser Tyr Lys Thr Ser Asn Ala Glu Gly His Val Asp Phe Ile Asn
1 5 10 15

Thr Tyr Asp Leu Glu Pro Met Ala Gln Gln Val Ile Pro Lys Ala Ala
20 25 30

Phe Gly Tyr Ile Ala Ser Gly Ala Glu Asp Thr Phe Thr Leu Arg Glu
35 40 45

Asn Ile Arg Ala Phe Asn His Lys Leu Ile Val Pro His Thr Leu Cys
50 55 60

Asn Val Glu Asn Pro Ser Thr Glu Ile Glu Phe Ala Gly Glu Lys Leu

65 70 75 80

Ser Ser Pro Ile Ile Met Ala Pro Val Ala Ala His Lys Leu Ala Asn
85 90 95

Glu Gln Gly Glu Val Ala Thr Ala Arg Gly Val His Glu Phe Gly Ser
100 105 110

Leu Tyr Thr Thr Ser Ser Tyr Ser Thr Val Asp Leu Pro Glu Ile Ser
115 120 125

Glu Ala Leu Gln Gly Thr Pro His Trp Phe Gln Phe Tyr Phe Ser Lys
130 135 140

Asp Asp Gly Ile Asn Arg His Ile Met Asp Arg Val Lys Ala Glu Gly
145 150 155 160

Tyr Lys Ala Ile Val Leu Thr Ala Asp Ala Thr Val Gly Gly Asn Arg
165 170 175

Glu Val Asp Lys Arg Asn Gly Phe Val Phe Pro Val Gly Met Pro Ile
180 185 190

Val Glu Glu Tyr Leu Pro Glu Gly Ala Gly Lys Ser Met Asp Phe Val
195 200 205

Tyr Lys Ser Ala Lys Gln Arg Leu Ser Pro Arg Asp Val Glu Phe Ile
210 215 220

Ala Glu Tyr Ser Gly Leu Pro Val Tyr Val Lys Gly Pro Gln Cys Arg
225 230 235 240

Glu Asp Val Glu Arg Ser Leu Ala Ala Gly Ala Ser Gly Ile Trp Val
245 250 255

Thr Asn His Gly Gly Arg Gln Ile Asp Gly Gly Pro Ala Ala Phe Asp
260 265 270

Ser Leu Gln Glu Val Ala Glu Ala Val Asp Arg Arg Val Pro Ile Val
275 280 285

```
Phe Asp Ser Gly Val Arg Arg Gly Gln His Val Phe Lys Ala Leu Ala
    290                 295                 300

Ser Gly Ala Asp Leu Val Ala Ile Gly Arg Pro Val Ile Tyr Gly Leu
305                 310                 315                 320

Ala Leu Gly Gly Ser Val Gly Val Arg Gln Val Phe Glu His Leu Asn
                325                 330                 335

Ala Glu Leu Lys Thr Val Met Gln Leu Ser Gly Thr Gln Thr Ile Glu
            340                 345                 350

Asp Val Lys His Phe Lys Leu Arg His Asn Pro Tyr Asn Pro Thr Phe
        355                 360                 365

Pro Val Asp Pro Arg Asp Leu Lys Leu Tyr
    370                 375

<210>  643
<211>  314
<212>  PRT
<213>  Streptococcus pneumoniae

<400>  643

Met Ser Glu Pro Leu Phe Leu Gln Ser Val Met Gln Glu Lys Ile Trp
1               5                   10                  15

Gly Gly Ala Lys Leu Arg Asp Glu Phe Gly Tyr Asp Ile Pro Ser Glu
            20                  25                  30

Lys Ile Gly Glu Tyr Trp Ala Ile Ser Ala His Pro Asn Gly Val Ser
        35                  40                  45

Lys Val Ala Asn Gly Arg Tyr Glu Gly Thr Asp Leu Ala Thr Leu Tyr
    50                  55                  60

Ala Glu His Arg Glu Leu Phe Gly Asn Arg Pro Glu Pro Val Phe Pro
65                  70                  75                  80

Leu Leu Thr Lys Ile Leu Asp Ala Asn Asp Trp Leu Ser Val Gln Val
                85                  90                  95
```

His Pro Asp Asp Ala Tyr Gly Leu Glu His Glu Gly Glu Leu Gly Lys
100 105 110

Thr Glu Cys Trp Tyr Ile Ile Ala Ala Asp Glu Gly Ser Glu Ile Ile
115 120 125

Tyr Gly His Asn Ala Lys Ser Lys Glu Glu Leu Arg Gln Gln Ile Glu
130 135 140

Asp Lys Asn Trp Asp Asp Leu Leu Thr Lys Val Pro Val Lys Ala Gly
145 150 155 160

Asp Phe Phe Tyr Val Pro Ser Gly Thr Met His Ala Ile Gly Ala Gly
165 170 175

Ile Leu Ile Leu Glu Thr Gln Gln Ser Ser Asp Thr Thr Tyr Arg Val
180 185 190

Tyr Asp Phe Asp Arg Lys Asp Asp Lys Gly Asn Leu Arg Glu Leu His
195 200 205

Leu Glu Lys Ser Ile Asp Val Leu Asn Ile Gly Glu Pro Ala Asn Ser
210 215 220

Arg Pro Val Thr Val Lys Ala Asp Asp Leu Arg Ser Thr Leu Leu Val
225 230 235 240

Ser Asn Asp Phe Phe Ala Val Tyr Lys Trp Glu Ile Thr Gly Lys Val
245 250 255

Asp Phe Glu Lys Thr Ala Asp Tyr Ser Leu Leu Ser Val Leu Ala Gly
260 265 270

Gln Gly Gln Leu Thr Val Asp Gly Lys Asn Tyr Pro Ile Gln Lys Gly
275 280 285

Ser His Phe Ile Leu Pro Ser Asp Val Glu Ala Trp Thr Leu Glu Gly
290 295 300

Gln Gly Leu Glu Leu Ile Val Ser His Pro
305 310

<210> 644
<211> 281
<212> PRT
<213> Streptococcus pneumoniae

<400> 644

```
Met Thr Trp Lys Ile Ile Ala Asp Ser Gly Cys Asp Tyr Arg Gln Leu
1               5                   10                  15

Pro Thr Pro Ala Ile Asn Thr Thr Phe Val Ser Val Pro Leu Thr Ile
            20                  25                  30

Gln Val Ala Asp Gln Val Phe Val Asp Asp Ala Ser Leu Asp Ile Asp
        35                  40                  45

Gln Met Met Glu Thr Met Tyr Ala Thr Ala Glu Ala Ser Lys Ser Ala
    50                  55                  60

Cys Pro Ser Pro Asp Asp Tyr Leu Arg Ala Phe Glu Gly Ala Lys Asn
65                  70                  75                  80

Ile Phe Leu Val Thr Ile Thr Gly Thr Leu Ser Gly Ser His Asn Ser
                85                  90                  95

Ala Gln Leu Ala Lys Asn Ile Tyr Leu Glu Asp His Pro Asp Thr Lys
            100                 105                 110

Ile His Val Ile Asp Ser Leu Ser Ala Gly Gly Glu Val Asp Leu Leu
        115                 120                 125

Val Glu Lys Leu Asn Asp Leu Ile Asp Gln Gly Leu Ser Phe Glu Glu
    130                 135                 140

Val Val Glu Ala Ile Thr Ala Tyr Gln Glu Lys Thr Lys Leu Leu Phe
145                 150                 155                 160

Val Leu Ala Lys Val Asp Asn Leu Val Lys Asn Gly Arg Leu Ser Lys
                165                 170                 175

Leu Ile Gly Thr Val Val Gly Leu Leu Asn Ile Arg Met Val Gly Lys
            180                 185                 190
```

Ala Ser Glu Thr Gly Thr Leu Glu Leu Leu Gln Lys Ala Arg Gly Ser
195 200 205

Lys Lys Ser Val Gln Ala Ala Tyr Asp Glu Leu Val Lys Ala Gly Tyr
210 215 220

Ala Gly Gly Arg Ile Val Met Ala Gln Arg Asn Asn Glu Lys Cys Cys
225 230 235 240

Gln Gln Leu Ser Glu Arg Ile Arg Glu Thr Phe Pro Gln Ala Asp Ile
245 250 255

Lys Ile Leu Pro Thr Ser Gly Leu Cys Ser Phe Tyr Ala Glu Glu Gly
260 265 270

Gly Leu Leu Met Gly Tyr Glu Ile Asp
275 280

<210> 645
<211> 216
<212> PRT
<213> Streptococcus pneumoniae

<400> 645

Met Lys Glu Gly Ile Pro Lys Met Gly Lys Ile Glu Val Ile Asn His
1 5 10 15

Pro Leu Ile Gln His Lys Leu Ser Ile Leu Arg Arg Thr Asp Thr Ser
20 25 30

Thr Lys Ala Phe Arg Glu Leu Val Asp Glu Ile Ala Met Leu Met Gly
35 40 45

Tyr Glu Val Leu Arg Asp Leu Pro Leu Glu Asp Val Glu Ile Glu Thr
50 55 60

Pro Ile Thr Lys Thr Val Gln Lys Gln Leu Ala Gly Lys Lys Leu Ala
65 70 75 80

Ile Val Pro Ile Leu Arg Ala Gly Ile Gly Met Val Asp Gly Leu Leu
85 90 95

Asn Leu Val Pro Ala Ala Lys Val Gly His Ile Gly Met Tyr Arg Asp
100 105 110

Glu Glu Thr Leu Gln Pro Val Glu Tyr Leu Val Lys Leu Pro Glu Asp
115 120 125

Ile Asp Gln Arg Gln Ile Phe Val Val Asp Pro Met Leu Ala Thr Gly
130 135 140

Gly Ser Ala Ile Leu Ala Val Asp Ser Leu Lys Lys Arg Gly Ala Ser
145 150 155 160

Asn Ile Lys Phe Val Cys Leu Val Ser Ala Pro Glu Gly Val Lys Ala
165 170 175

Leu Gln Glu Ala His Pro Asp Val Glu Ile Phe Thr Ala Ala Leu Asp
180 185 190

Glu Arg Leu Asn Glu His Gly Tyr Ile Val Pro Gly Leu Gly Asp Ala
195 200 205

Gly Asp Arg Leu Phe Gly Thr Lys
210 215

<210> 646
<211> 252
<212> PRT
<213> Streptococcus pneumoniae

<400> 646

Met Ile Ser Pro Ser Ala Thr Gln Asp Gly Leu Thr Lys Gly Gln Asp
1 5 10 15

Tyr Leu Phe Ile Gly Thr Phe Gln Asp Ser Phe Gln Gly Lys Ile Ile
20 25 30

Ser Asn Tyr Val Ser Glu Lys Leu Asn Ala Lys Lys Val Val Leu Tyr
35 40 45

Thr Asp Asn Ala Ser Asp Tyr Ala Lys Gly Ile Ala Lys Ser Phe Arg
50 55 60

```
Glu Ser Tyr Lys Gly Glu Ile Val Ala Asp Glu Thr Phe Val Ala Gly
65                  70                  75                  80

Asp Thr Asp Phe Gln Ala Ala Leu Thr Lys Met Lys Gly Lys Asp Phe
                85                  90                  95

Asp Ala Ile Val Val Pro Gly Tyr Tyr Asn Glu Ala Gly Lys Ile Val
            100                 105                 110

Asn Gln Ala Arg Gly Met Gly Ile Asp Lys Pro Ile Val Gly Gly Asp
        115                 120                 125

Gly Phe Asn Gly Glu Glu Phe Val Gln Gln Ala Thr Ala Glu Lys Ala
    130                 135                 140

Ser Asn Ile Tyr Phe Ile Ser Gly Phe Ser Thr Thr Val Glu Val Ser
145                 150                 155                 160

Ala Lys Ala Lys Ala Phe Leu Asp Ala Tyr Arg Ala Lys Tyr Asn Glu
                165                 170                 175

Glu Pro Ser Thr Phe Ala Ala Leu Ala Tyr Asp Ser Val His Leu Val
            180                 185                 190

Ala Asn Ala Ala Lys Gly Ala Lys Asn Ser Gly Glu Ile Lys Asn Asn
        195                 200                 205

Leu Ala Lys Thr Lys Asp Phe Glu Gly Val Thr Gly Gln Thr Ser Phe
    210                 215                 220

Asp Ala Asp His Asn Thr Val Lys Thr Ala Tyr Met Met Thr Met Asn
225                 230                 235                 240

Asn Gly Lys Val Glu Ala Ala Glu Val Val Lys Pro
                245                 250
```

<210> 647
<211> 396
<212> PRT
<213> Streptococcus pneumoniae

<400> 647

```
Met Ser Glu Arg Lys Leu Phe Thr Ser Glu Ser Val Ser Glu Gly His
1               5                   10                  15

Pro Asp Lys Ile Ala Asp Gln Ile Ser Asp Ala Ile Leu Asp Ala Ile
            20                  25                  30

Leu Ala Lys Asp Pro Glu Ala His Val Ala Ala Glu Thr Ala Val Tyr
        35                  40                  45

Thr Gly Ser Val His Val Phe Gly Glu Ile Ser Thr Asn Ala Tyr Val
    50                  55                  60

Asp Ile Asn Arg Val Val Arg Asp Thr Ile Ala Glu Ile Gly Tyr Thr
65                  70                  75                  80

Asn Thr Glu Tyr Gly Phe Ser Ala Glu Thr Val Gly Val His Pro Ser
                85                  90                  95

Leu Val Glu Gln Ser Pro Asp Ile Ala Gln Gly Val Asn Glu Ala Leu
            100                 105                 110

Glu Val Arg Gly Asn Ala Asp Gln Asp Pro Leu Asp Leu Ile Gly Ala
        115                 120                 125

Gly Asp Gln Gly Leu Met Phe Gly Phe Ala Val Asp Glu Thr Glu Glu
    130                 135                 140

Leu Met Pro Leu Pro Ile Ala Leu Ser His Lys Leu Val Arg Arg Leu
145                 150                 155                 160

Ala Glu Leu Arg Lys Ser Gly Glu Ile Ser Tyr Leu Arg Pro Asp Ala
                165                 170                 175

Lys Ser Gln Val Thr Val Glu Tyr Asp Glu Asn Asp Arg Pro Val Arg
            180                 185                 190

Val Asp Thr Val Val Ile Ser Thr Gln His Asp Pro Glu Ala Thr Asn
        195                 200                 205

Glu Gln Ile His Gln Asp Val Ile Asp Lys Val Ile Lys Glu Val Ile
    210                 215                 220
```

Pro Ser Ser Tyr Leu Asp Asp Lys Thr Lys Phe Phe Ile Asn Pro Thr
225 230 235 240

Gly Arg Phe Val Ile Gly Gly Pro Gln Gly Asp Ser Gly Leu Thr Gly
245 250 255

Arg Lys Ile Ile Val Asp Thr Tyr Gly Gly Tyr Ser Arg His Gly Gly
260 265 270

Gly Ala Phe Ser Gly Lys Asp Ala Thr Lys Val Asp Arg Ser Ala Ser
275 280 285

Tyr Ala Ala Arg Tyr Ile Ala Lys Asn Ile Val Ala Ala Asp Leu Ala
290 295 300

Lys Lys Ala Glu Val Gln Leu Ala Tyr Ala Ile Gly Val Ala Gln Pro
305 310 315 320

Val Ser Val Arg Ile Asp Thr Phe Gly Thr Gly Thr Val Ala Glu Ser
325 330 335

Gln Leu Glu Lys Ala Ala Arg Gln Ile Phe Asp Leu Arg Pro Ala Gly
340 345 350

Ile Ile Gln Met Leu Asp Leu Lys Arg Pro Ile Tyr Arg Gln Thr Ser
355 360 365

Ala Tyr Gly His Met Gly Arg Thr Asp Ile Asp Leu Pro Trp Glu Arg
370 375 380

Leu Asp Lys Val Asp Ala Leu Lys Glu Ala Val Lys
385 390 395

<210> 648
<211> 90
<212> PRT
<213> Streptococcus pneumoniae

<400> 648

Met Ala Val Lys Ile Arg Leu Thr Arg Met Gly Ser Lys Lys Lys Pro
1 5 10 15

Phe Tyr Arg Ile Asn Val Ala Asp Ser Arg Ser Pro Arg Asp Gly Arg
            20   25   30

Phe Ile Glu Thr Val Gly Thr Tyr Asn Pro Leu Val Ala Glu Asn Gln
        35   40   45

Val Thr Leu Lys Glu Asp Arg Val Leu Ala Trp Leu Ala Asn Gly Ala
    50   55   60

Gln Pro Ser Asp Thr Val Arg Asn Ile Leu Ser Lys Glu Gly Val Leu
65   70   75   80

Lys Lys Phe His Asp Ser Lys Phe Ser Lys
                85   90

<210> 649
<211> 112
<212> PRT
<213> Streptococcus pneumoniae

<400> 649

Met Gln Val Ile Lys Arg Asn Gly Glu Ile Ala Glu Phe Asn Pro Asp
1   5   10   15

Lys Ile Tyr Gln Ala Ile Leu Lys Ala Ala Gln Thr Val Tyr Val Leu
            20   25   30

Thr Asp Asp Leu Arg Gln Asn Leu Ala Gln Val Thr Lys Lys Val Val
        35   40   45

Leu Asp Leu Gln Glu Ala Lys Val Glu Arg Ala Thr Ile Ser Met Ile
    50   55   60

Gln Ser Met Val Glu His Arg Leu Leu Gly Ala Gly Tyr Ile Thr Ile
65   70   75   80

Ala Glu His Tyr Ile Ser Tyr Arg Leu Gln Arg Asp Leu Glu Arg Ser
                85   90   95

Gly Tyr Gly Asp His Ile Ala Val His Leu His Phe Glu Gln Ile Arg
            100   105   110

<210> 650
<211> 752
<212> PRT
<213> Streptococcus pneumoniae

<400> 650

Met Leu Cys Gln Asn Cys Lys Ile Asn Asp Ser Thr Ile His Leu Tyr
1 5 10 15

Thr Asn Leu Asn Gly Lys Gln Lys Gln Ile Asp Leu Cys Gln Asn Cys
20 25 30

Tyr Lys Ile Ile Lys Thr Asp Pro Asn Asn Ser Leu Phe Lys Gly Met
35 40 45

Thr Asp Leu Asn Asn Arg Asp Phe Asp Pro Phe Gly Asp Phe Phe Asn
50 55 60

Asp Leu Asn Asn Phe Arg Pro Ser Ser Asn Thr Pro Pro Ile Pro Pro
65 70 75 80

Thr Gln Ser Gly Gly Gly Tyr Gly Gly Asn Gly Gly Tyr Gly Ser Gln
85 90 95

Asn Arg Gly Ser Ala Gln Thr Pro Pro Pro Ser Gln Glu Lys Gly Leu
100 105 110

Leu Glu Glu Phe Gly Ile Asn Val Thr Glu Ile Ala Arg Arg Gly Asp
115 120 125

Ile Asp Pro Val Ile Gly Arg Asp Asp Glu Ile Ile Arg Val Ile Glu
130 135 140

Ile Leu Asn Arg Arg Thr Lys Asn Asn Pro Val Leu Ile Gly Glu Pro
145 150 155 160

Gly Val Gly Lys Thr Ala Val Val Glu Gly Leu Ala Gln Lys Ile Val
165 170 175

Asp Gly Asp Val Pro His Lys Leu Gln Gly Lys Gln Val Ile Arg Leu
180 185 190

Asp Val Val Ser Leu Val Gln Gly Thr Gly Ile Arg Gly Gln Phe Glu
        195   200   205

Glu Arg Met Gln Lys Leu Met Glu Glu Ile Arg Lys Arg Glu Asp Ile
    210   215   220

Ile Leu Phe Ile Asp Glu Ile His Glu Ile Val Gly Ala Gly Ser Ala
225   230   235   240

Ser Asp Gly Asn Met Asp Ala Gly Asn Ile Leu Lys Pro Ala Leu Ala
                245   250   255

Arg Gly Glu Leu Gln Leu Val Gly Ala Thr Thr Leu Asn Glu Tyr Arg
            260   265   270

Ile Ile Glu Lys Asp Ala Ala Leu Glu Arg Arg Met Gln Pro Val Lys
        275   280   285

Val Asp Glu Pro Thr Val Asp Glu Thr Ile Thr Ile Leu Lys Gly Ile
    290   295   300

Gln Lys Lys Tyr Glu Asp Tyr His His Val Gln Tyr Thr Asp Ala Ala
305   310   315   320

Ile Glu Ala Ala Ala Thr Leu Ser Asn Arg Tyr Ile Gln Asp Arg Phe
                325   330   335

Leu Pro Asp Lys Ala Ile Asp Leu Leu Asp Glu Ala Gly Ser Lys Met
            340   345   350

Asn Leu Thr Leu Asn Phe Val Asp Pro Lys Val Ile Asp Gln Arg Leu
        355   360   365

Ile Glu Ala Glu Asn Leu Lys Ser Gln Ala Thr Arg Glu Glu Asp Phe
    370   375   380

Glu Lys Ala Ala Tyr Phe Arg Asp Gln Ile Ala Lys Tyr Lys Glu Met
385   390   395   400

Gln Lys Lys Lys Ile Thr Asp Gln Asp Thr Pro Ser Ile Ser Glu Lys

405 410 415

Thr Ile Glu His Ile Ile Glu Gln Lys Thr Asn Ile Pro Val Gly Asp
420 425 430

Leu Lys Glu Lys Glu Gln Ser Gln Leu Ile His Leu Ala Glu Asp Leu
435 440 445

Lys Ser His Val Ile Gly Gln Asp Asp Ala Val Asp Lys Ile Ala Lys
450 455 460

Ala Ile Arg Arg Asn Arg Val Gly Leu Gly Thr Pro Asn Arg Pro Ile
465 470 475 480

Gly Ser Phe Leu Phe Val Gly Pro Thr Gly Val Gly Lys Thr Glu Leu
485 490 495

Ser Lys Gln Leu Ala Ile Glu Leu Phe Gly Ser Ala Asp Ser Met Ile
500 505 510

Arg Phe Asp Met Ser Glu Tyr Met Glu Lys His Ser Val Ala Lys Leu
515 520 525

Val Gly Ala Pro Pro Gly Tyr Val Gly Tyr Asp Glu Ala Gly Gln Leu
530 535 540

Thr Glu Lys Val Arg His Asn Pro Tyr Ser Leu Ile Leu Leu Asp Glu
545 550 555 560

Val Glu Lys Ala His Pro Asp Val Met His Met Phe Leu Gln Val Leu
565 570 575

Asp Asp Gly Arg Leu Thr Asp Gly Gln Gly Arg Thr Val Ser Phe Lys
580 585 590

Asp Ala Ile Ile Ile Met Thr Ser Asn Ala Gly Thr Gly Lys Thr Glu
595 600 605

Ala Ser Val Gly Phe Gly Ala Ala Arg Glu Gly Arg Thr Asn Ser Val
610 615 620

Leu Gly Glu Leu Gly Asn Phe Phe Ser Pro Glu Phe Met Asn Arg Phe
625 630 635 640

Asp Gly Ile Ile Glu Phe Lys Ala Leu Ser Lys Asp Asn Leu Leu Gln
645 650 655

Ile Val Glu Leu Met Leu Ala Asp Val Asn Lys Arg Leu Ser Ser Asn
660 665 670

Asn Ile Arg Leu Asp Val Thr Asp Lys Val Lys Glu Lys Leu Val Asp
675 680 685

Leu Gly Tyr Asp Pro Lys Met Gly Ala Arg Pro Leu Arg Arg Thr Ile
690 695 700

Gln Asp Tyr Ile Glu Asp Thr Ile Thr Asp Tyr Tyr Leu Glu Asn Pro
705 710 715 720

Ser Glu Lys Asp Leu Lys Ala Val Met Thr Ser Lys Gly Asn Ile Gln
725 730 735

Ile Lys Ser Ala Lys Lys Ala Glu Val Lys Ser Ser Glu Lys Glu Lys
740 745 750

<210> 651
<211> 400
<212> PRT
<213> Streptococcus pneumoniae

<400> 651

Met Asn Glu Phe Glu Asp Leu Leu Asn Ser Val Ser Gln Val Glu Thr
1 5 10 15

Gly Asp Val Val Ser Ala Glu Val Leu Thr Val Asp Ala Thr Gln Ala
20 25 30

Asn Val Ala Ile Ser Gly Thr Gly Val Glu Gly Val Leu Thr Leu Arg
35 40 45

Glu Leu Thr Asn Asp Arg Asp Ala Asp Ile Asn Asp Phe Val Lys Val
50 55 60

Gly Glu Val Leu Asp Val Leu Val Leu Arg Gln Val Val Gly Lys Asp
65 70 75 80

Thr Asp Thr Val Thr Tyr Leu Val Ser Lys Lys Arg Leu Glu Ala Arg
85 90 95

Lys Ala Trp Asp Lys Leu Val Gly Arg Glu Glu Glu Val Val Thr Val
100 105 110

Lys Gly Thr Arg Ala Val Lys Gly Gly Leu Ser Val Glu Phe Glu Gly
115 120 125

Val Arg Gly Phe Ile Pro Ala Ser Met Leu Asp Thr Arg Phe Val Arg
130 135 140

Asn Ala Glu Arg Phe Val Gly Gln Glu Phe Asp Thr Lys Ile Lys Glu
145 150 155 160

Val Asn Ala Lys Glu Asn Arg Phe Ile Leu Ser Arg Arg Glu Val Val
165 170 175

Glu Ala Ala Thr Ala Ala Ala Arg Ala Glu Val Phe Gly Lys Leu Ala
180 185 190

Val Gly Asp Val Val Thr Gly Lys Val Ala Arg Ile Thr Ser Phe Gly
195 200 205

Ala Phe Val Asp Leu Gly Gly Val Asp Gly Leu Val His Leu Thr Glu
210 215 220

Leu Ser His Glu Arg Asn Val Ser Pro Lys Ser Val Val Thr Val Gly
225 230 235 240

Glu Glu Ile Glu Val Lys Ile Leu Asp Leu Asn Glu Glu Glu Gly Arg
245 250 255

Val Ser Leu Ser Leu Lys Ala Thr Val Pro Gly Pro Trp Asp Gly Val
260 265 270

Glu Gln Lys Leu Ala Lys Gly Asp Val Val Glu Gly Thr Val Lys Arg
275 280 285

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Leu Thr Asp Phe Gly Ala Phe Val Glu Val Leu Pro Gly Ile Asp Gly
    290                 295                 300

Leu Val His Val Ser Gln Ile Ser His Lys Arg Ile Glu Asn Pro Lys
305                 310                 315                 320

Glu Ala Leu Lys Val Gly Gln Glu Val Gln Val Lys Val Leu Glu Val
                325                 330                 335

Asn Ala Asp Ala Glu Arg Val Ser Leu Ser Ile Lys Ala Leu Glu Glu
            340                 345                 350

Arg Pro Ala Gln Glu Glu Gly Gln Lys Glu Glu Lys Arg Ala Ala Arg
        355                 360                 365

Pro Arg Arg Pro Arg Arg Gln Glu Lys Arg Asp Phe Glu Leu Pro Glu
    370                 375                 380

Thr Gln Thr Gly Phe Ser Met Ala Asp Leu Phe Gly Asp Ile Glu Leu
385                 390                 395                 400


<210>  652
<211>  470
<212>  PRT
<213>  Streptococcus pneumoniae

<400>  652

Met Ala Glu Glu Arg Val Glu Pro Lys Pro Ile Asp Leu Gly Glu Tyr
1               5                   10                  15

Lys Phe Gly Phe His Asp Asp Val Glu Pro Val Leu Ser Thr Gly Lys
            20                  25                  30

Gly Leu Asn Glu Gly Val Ile Arg Glu Leu Ser Ala Ala Lys Gly Glu
        35                  40                  45

Pro Glu Trp Met Leu Glu Phe Arg Leu Lys Ser Tyr Glu Thr Phe Lys
    50                  55                  60

Lys Met Pro Met Gln Thr Trp Gly Ala Asp Leu Ser Glu Ile Asp Phe
65                  70                  75                  80
```

Asp Asp Leu Ile Tyr Tyr Gln Lys Pro Ser Asp Lys Pro Ala Arg Ser
85 90 95

Trp Asp Asp Val Pro Glu Lys Ile Lys Glu Thr Phe Glu Arg Ile Gly
100 105 110

Ile Pro Glu Ala Glu Arg Ala Tyr Leu Ala Gly Ala Ser Ala Gln Tyr
115 120 125

Glu Ser Glu Val Val Tyr His Asn Met Lys Glu Glu Phe Gln Lys Leu
130 135 140

Gly Ile Ile Phe Thr Asp Thr Asp Ser Ala Leu Lys Glu Tyr Pro Asp
145 150 155 160

Leu Phe Lys Gln Tyr Phe Ala Lys Leu Val Pro Pro Thr Asp Asn Lys
165 170 175

Leu Ala Ala Leu Asn Ser Ala Val Trp Ser Gly Gly Thr Phe Ile Tyr
180 185 190

Val Pro Lys Gly Val Lys Val Asp Ile Pro Leu Gln Thr Tyr Phe Arg
195 200 205

Ile Asn Asn Glu Asn Ile Gly Gln Phe Glu Arg Thr Leu Ile Ile Val
210 215 220

Asp Glu Gly Ala Ser Val Tyr Tyr Val Glu Gly Cys Thr Ala Pro Thr
225 230 235 240

Tyr Ser Ser Asn Ser Leu His Ala Ala Ile Val Glu Ile Phe Ala Leu
245 250 255

Asp Gly Ala Tyr Met Arg Tyr Thr Thr Ile Gln Asn Trp Ser Asp Asn
260 265 270

Val Tyr Asn Leu Val Thr Lys Arg Ala Lys Ala Gln Lys Asp Ala Thr
275 280 285

Val Glu Trp Ile Asp Gly Asn Leu Gly Ala Lys Thr Thr Met Lys Tyr
290 295 300

Pro Ser Val Tyr Leu Asp Gly Glu Gly Ala Arg Gly Thr Met Leu Ser
305 310 315 320

Ile Ala Phe Ala Asn Ala Gly Gln His Gln Asp Thr Gly Ala Lys Met
325 330 335

Ile His Asn Ala Pro His Thr Ser Ser Ser Ile Val Ser Lys Ser Ile
340 345 350

Ala Lys Gly Gly Gly Lys Val Asp Tyr Arg Gly Gln Val Thr Phe Asn
355 360 365

Lys Asn Ser Lys Lys Ser Val Ser His Ile Glu Cys Asp Thr Ile Ile
370 375 380

Met Asp Asp Leu Ser Ala Ser Asp Thr Ile Pro Phe Asn Glu Ile His
385 390 395 400

Asn Ser Gln Val Ala Leu Glu His Glu Ala Lys Val Ser Lys Ile Ser
405 410 415

Glu Glu Gln Leu Tyr Tyr Leu Met Ser Arg Gly Leu Ser Glu Ser Glu
420 425 430

Ala Thr Glu Met Ile Val Met Gly Phe Val Glu Pro Phe Thr Lys Glu
435 440 445

Leu Pro Met Glu Tyr Ala Val Glu Leu Asn Arg Leu Ile Ser Tyr Glu
450 455 460

Met Glu Gly Ser Val Gly
465 470

<210> 653
<211> 413
<212> PRT
<213> Streptococcus pneumoniae

<400> 653

Met Lys Lys Ile Phe Leu Thr Leu Leu Thr Val Ser Leu Leu Gly Gly
1 5 10 15

Ala Ser Thr Ala Val Ala Gln Asp Phe Thr Ile Ala Ala Lys His Ala
20 25 30

Ile Ala Val Glu Ala Asn Thr Gly Lys Ile Leu Tyr Glu Lys Asp Ala
35 40 45

Thr Gln Pro Val Glu Ile Ala Ser Ile Thr Lys Leu Ile Thr Val Tyr
50 55 60

Leu Val Tyr Glu Ala Leu Glu Asn Gly Ser Ile Thr Leu Ser Thr Pro
65 70 75 80

Val Asp Ile Ser Asp Tyr Pro Tyr Gln Leu Thr Thr Asn Ser Glu Ala
85 90 95

Ser Asn Ile Pro Met Glu Ala Arg Asn Tyr Thr Val Glu Glu Leu Leu
100 105 110

Glu Ala Thr Leu Val Ser Ser Ala Asn Ser Ala Ala Ile Ala Leu Ala
115 120 125

Glu Lys Ile Ala Gly Ser Glu Lys Asp Phe Val Asp Met Met Arg Ala
130 135 140

Lys Leu Leu Glu Trp Gly Ile Gln Asp Ala Thr Val Val Asn Thr Thr
145 150 155 160

Gly Leu Asn Asn Glu Thr Leu Gly Asp Asn Ile Tyr Pro Gly Ser Lys
165 170 175

Lys Asp Glu Glu Asn Lys Leu Ser Ala Tyr Asp Val Ala Ile Val Ala
180 185 190

Arg Asn Leu Ile Lys Lys Tyr Pro Gln Val Leu Glu Ile Thr Lys Lys
195 200 205

Pro Ser Ser Thr Phe Ala Gly Met Thr Ile Thr Ser Thr Asn Tyr Met
210 215 220

Leu Glu Gly Met Pro Ala Tyr Arg Gly Gly Phe Asp Gly Leu Lys Thr

225 230 235 240

Gly Thr Thr Asp Lys Ala Gly Glu Ser Phe Val Gly Thr Thr Val Glu
245 250 255

Lys Gly Met Arg Val Ile Thr Val Val Leu Asn Ala Asp His Gln Asp
260 265 270

Asn Asn Pro Tyr Ala Arg Phe Thr Ala Thr Ser Ser Leu Met Asp Tyr
275 280 285

Ile Ser Ser Thr Phe Thr Leu Arg Lys Ile Val Gln Gln Gly Asp Ala
290 295 300

Tyr Gln Asp Ser Lys Ala Pro Val Gln Asp Gly Lys Glu Asp Thr Val
305 310 315 320

Thr Ala Val Ala Pro Glu Asp Ile Tyr Leu Ile Glu Arg Val Gly Asn
325 330 335

Gln Ser Ser Gln Ser Val Gln Phe Thr Pro Asp Ser Lys Ala Ile Pro
340 345 350

Ala Pro Leu Glu Ala Gly Thr Val Val Gly His Leu Thr Tyr Glu Asp
355 360 365

Lys Asp Leu Ile Gly Gln Gly Tyr Ile Thr Thr Glu Arg Pro Ser Phe
370 375 380

Glu Met Val Ala Asp Lys Lys Ile Glu Lys Ala Phe Phe Leu Lys Val
385 390 395 400

Trp Trp Asn Gln Phe Val Arg Phe Val Asn Glu Lys Leu
405 410

<210> 654
<211> 335
<212> PRT
<213> Streptococcus pneumoniae

<400> 654

Met Lys Arg Ile Ala Val Leu Thr Ser Gly Gly Asp Ala Pro Gly Met

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1               5                   10                  15

Asn Ala Ala Ile Arg Ala Val Val Arg Gln Ala Ile Ser Glu Gly Met
            20                  25                  30

Glu Val Phe Gly Ile Tyr Asp Gly Tyr Ala Gly Met Val Ala Gly Glu
        35                  40                  45

Ile His Pro Leu Asp Ala Ala Ser Val Gly Asp Ile Ile Ser Arg Gly
    50                  55                  60

Gly Thr Phe Leu His Ser Ala Arg Tyr Pro Glu Phe Ala Gln Leu Glu
65                  70                  75                  80

Gly Gln Leu Lys Gly Ile Glu Gln Leu Lys Lys His Gly Ile Glu Gly
                85                  90                  95

Val Val Val Ile Gly Gly Asp Gly Ser Tyr His Gly Ala Met Arg Leu
            100                 105                 110

Thr Glu His Gly Phe Pro Ala Ile Gly Leu Pro Gly Thr Ile Asp Asn
        115                 120                 125

Asp Ile Val Gly Thr Asp Phe Thr Ile Gly Phe Asp Thr Ala Val Thr
    130                 135                 140

Thr Ala Met Asp Ala Ile Asp Lys Ile Arg Asp Thr Ser Ser Ser His
145                 150                 155                 160

Arg Arg Thr Phe Val Ile Glu Val Met Gly Arg Asn Ala Gly Asp Ile
                165                 170                 175

Ala Leu Trp Ala Gly Ile Ala Thr Gly Ala Asp Glu Ile Ile Ile Pro
            180                 185                 190

Glu Ala Gly Phe Lys Met Glu Asp Ile Val Ala Ser Ile Lys Ala Gly
        195                 200                 205

Tyr Glu Cys Gly Lys Lys His Asn Ile Ile Val Leu Ala Glu Gly Val
    210                 215                 220
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Met Ser Ala Ala Glu Phe Gly Gln Lys Leu Lys Glu Ala Gly Asp Thr
225 230 235 240

Ser Asp Leu Arg Val Thr Glu Leu Gly His Ile Gln Arg Gly Gly Ser
245 250 255

Pro Thr Ala Arg Asp Arg Val Leu Ala Ser Arg Met Gly Ala His Ala
260 265 270

Val Lys Leu Leu Lys Glu Gly Ile Gly Gly Val Ala Val Gly Ile Arg
275 280 285

Asn Glu Lys Met Val Glu Asn Pro Ile Leu Gly Thr Ala Glu Glu Gly
290 295 300

Ala Leu Phe Ser Leu Thr Ala Glu Gly Lys Ile Val Val Asn Asn Pro
305 310 315 320

His Lys Ala Asp Ile Glu Leu Ser Ser Leu Asn Lys Ser Leu Ser
325 330 335

<210> 655
<211> 501
<212> PRT
<213> Streptococcus pneumoniae

<400> 655

Met Asn Lys Arg Val Lys Ile Val Ala Thr Leu Gly Pro Ala Val Glu
1 5 10 15

Ile Arg Gly Gly Lys Lys Phe Gly Glu Asp Gly Tyr Trp Gly Glu Lys
20 25 30

Leu Asp Val Glu Ala Ser Ala Lys Asn Ile Ala Lys Leu Ile Glu Ala
35 40 45

Gly Ala Asn Thr Phe Arg Phe Asn Phe Ser His Gly Asp His Gln Glu
50 55 60

Gln Gly Glu Arg Met Ala Thr Val Lys Leu Ala Glu Lys Ile Ala Gly
65 70 75 80

Lys Lys Val Gly Phe Leu Leu Asp Thr Lys Gly Pro Glu Ile Arg Thr
85 90 95

Glu Leu Phe Glu Gly Glu Ala Lys Glu Tyr Ser Tyr Lys Thr Gly Glu
100 105 110

Lys Ile Arg Val Ala Thr Lys Gln Gly Ile Lys Ser Thr Arg Glu Val
115 120 125

Ile Ala Leu Asn Val Ala Gly Ala Leu Asp Ile Tyr Asp Asp Val Glu
130 135 140

Val Gly Arg Gln Val Leu Val Asp Asp Gly Lys Leu Gly Leu Arg Val
145 150 155 160

Val Ala Lys Asp Asp Ala Thr Arg Glu Phe Glu Val Glu Val Glu Asn
165 170 175

Asp Gly Ile Ile Ala Lys Gln Lys Gly Val Asn Ile Pro Asn Thr Lys
180 185 190

Ile Pro Phe Pro Ala Leu Ala Glu Arg Asp Asn Asp Asp Ile Arg Phe
195 200 205

Gly Leu Glu Gln Gly Ile Asn Phe Ile Ala Ile Ser Phe Val Arg Thr
210 215 220

Ala Lys Asp Val Asn Glu Val Arg Ala Ile Cys Glu Glu Thr Gly Asn
225 230 235 240

Gly His Val Gln Leu Phe Ala Lys Ile Glu Asn Gln Gln Gly Ile Asp
245 250 255

Asn Leu Asp Glu Ile Ile Glu Ala Ala Asp Gly Ile Met Ile Ala Arg
260 265 270

Gly Asp Met Gly Ile Glu Val Pro Phe Glu Met Val Pro Val Tyr Gln
275 280 285

Lys Met Ile Ile Lys Lys Val Asn Ala Ala Gly Lys Val Val Ile Thr
290 295 300

Ala Thr Asn Met Leu Glu Thr Met Thr Glu Lys Pro Arg Ala Thr Arg
305 310 315 320

Ser Glu Val Ser Asp Val Phe Asn Ala Val Ile Asp Gly Thr Asp Ala
325 330 335

Thr Met Leu Ser Gly Glu Ser Ala Asn Gly Lys Tyr Pro Leu Glu Ser
340 345 350

Val Thr Thr Met Ala Thr Ile Asp Lys Asn Ala Gln Ala Leu Leu Asn
355 360 365

Glu Tyr Gly Arg Leu Asp Ser Asp Ser Phe Glu Arg Asn Ser Lys Thr
370 375 380

Glu Val Met Ala Ser Ala Val Lys Asp Ala Thr Ser Ser Met Asp Ile
385 390 395 400

Lys Leu Val Val Thr Leu Thr Lys Thr Gly His Thr Ala Arg Leu Ile
405 410 415

Ser Lys Tyr Arg Pro Asn Ala Asp Ile Leu Ala Leu Thr Phe Asp Glu
420 425 430

Leu Thr Glu Arg Gly Leu Met Leu Asn Trp Gly Val Ile Pro Met Leu
435 440 445

Thr Asp Ala Pro Ser Ser Thr Asp Asp Met Phe Glu Ile Ala Glu Arg
450 455 460

Lys Ala Val Glu Ala Gly Leu Val Glu Ser Gly Asp Asp Ile Val Ile
465 470 475 480

Val Ala Gly Val Pro Val Gly Glu Ala Val Arg Thr Asn Thr Met Arg
485 490 495

Ile Arg Thr Val Arg
500

<210> 656
<211> 491

<212> PRT
<213> Streptococcus pneumoniae

<400> 656

Met Lys Glu Leu Asp Gln Asn Gln Ala Pro Ile Tyr Glu Ala Leu Val
1 5 10 15

Lys Leu Arg Lys Lys Arg Ile Val Pro Phe Asp Val Pro Gly His Lys
20 25 30

Arg Gly Arg Gly Asn Pro Glu Leu Val Glu Leu Leu Gly Glu Lys Cys
35 40 45

Val Gly Ile Asp Val Asn Ser Met Lys Pro Leu Asp Asn Leu Gly His
50 55 60

Pro Ile Ser Ile Ile Arg Asp Ala Glu Glu Leu Ala Ala Asp Ala Phe
65 70 75 80

Gly Ala Ser His Ala Phe Leu Met Ile Gly Gly Thr Thr Ser Ser Val
85 90 95

Gln Thr Met Ile Leu Ala Thr Cys Lys Ala Gly Asp Lys Ile Ile Leu
100 105 110

Pro Arg Asn Val His Lys Ser Ala Ile Asn Ala Leu Val Leu Cys Gly
115 120 125

Ala Ile Pro Ile Tyr Ile Glu Met Ser Val Asp Pro Lys Ile Gly Ile
130 135 140

Ala Leu Gly Leu Glu Asn Asp Arg Val Ala Gln Ala Ile Lys Asp His
145 150 155 160

Pro Asp Ala Lys Ala Ile Leu Ile Asn Asn Pro Thr Tyr Tyr Gly Ile
165 170 175

Cys Ser Asp Leu Lys Gly Leu Thr Glu Met Ala His Glu Ala Gly Met
180 185 190

Met Val Leu Val Asp Glu Ala His Gly Ala His Leu His Phe Thr Asp
195 200 205

Lys Leu Pro Ile Ser Ala Met Asp Ala Gly Ala Asp Met Ala Ala Val
    210   215   220

Ser Met His Lys Ser Gly Gly Ser Leu Thr Gln Ser Ser Ile Leu Leu
225   230   235   240

Ile Gly Glu Gln Met Asn Ser Glu Tyr Val Arg Gln Ile Ile Asn Leu
                245   250   255

Thr Gln Ser Thr Ser Ala Ser Tyr Leu Leu Met Ala Ser Leu Asp Ile
            260   265   270

Ser Arg Arg Asn Leu Ala Leu Arg Gly Lys Glu Ser Phe Glu Lys Val
        275   280   285

Ile Glu Leu Ser Glu Tyr Ala Arg Arg Glu Ile Asn Ala Ile Gly Gly
    290   295   300

Tyr Tyr Ala Tyr Ser Lys Glu Leu Ile Asp Gly Val Ser Val Cys Asp
305   310   315   320

Phe Asp Val Thr Lys Leu Ser Val Tyr Thr Gln Gly Ile Gly Leu Thr
                325   330   335

Gly Ile Glu Val Tyr Asp Leu Leu Arg Asp Glu Tyr Asp Ile Gln Ile
            340   345   350

Glu Phe Gly Asp Ile Gly Asn Ile Leu Ala Tyr Ile Ser Ile Gly Asp
        355   360   365

Arg Ile Gln Asp Ile Glu Arg Leu Val Gly Ala Leu Ala Asp Ile Lys
    370   375   380

Arg Leu Tyr Ser Arg Asp Gly Lys Asp Leu Ile Ala Gly Glu Tyr Ile
385   390   395   400

Gln Pro Glu Leu Val Leu Ser Pro Gln Glu Ala Phe Tyr Ser Glu Arg
                405   410   415

Lys Ser Leu Thr Leu Asp Asp Ser Val Gly Gln Val Cys Gly Glu Phe

420 425 430

Val Met Cys Tyr Pro Pro Gly Ile Pro Ile Leu Ala Pro Gly Glu Arg
435 440 445

Ile Thr Arg Glu Ile Val Asp Tyr Ile Gln Phe Ala Lys Glu Arg Gly
450 455 460

Cys Ser Leu Gln Gly Thr Glu Asp Pro Glu Val Asn His Ile Asn Val
465 470 475 480

Ile Lys Arg Lys Thr Asn Tyr Lys Lys Ser Gln
485 490

<210> 657
<211> 286
<212> PRT
<213> Streptococcus pneumoniae

<400> 657

Met Asp Leu Trp Phe Ser Glu Val His Thr Pro Asp Val Lys Leu Ser
1 5 10 15

Leu Arg Thr Ala Lys Gln Leu Tyr Ala Gly Lys Ser Glu Trp Gln Asp
20 25 30

Ile Glu Val Leu Asp Thr Pro Ala Phe Gly Lys Ile Leu Ile Leu Asn
35 40 45

Gly His Val Leu Phe Ser Asp Ala Asp Asp Phe Val Tyr Asn Glu Met
50 55 60

Thr Val His Val Pro Met Ala Val His Pro Asn Pro Lys Lys Val Leu
65 70 75 80

Val Ile Gly Gly Gly Asp Gly Gly Val Ala Gln Val Leu Thr Leu Tyr
85 90 95

Pro Glu Leu Glu Gln Ile Asp Ile Val Glu Pro Asp Glu Met Leu Val
100 105 110

Glu Val Cys Arg Glu Tyr Phe Pro Asp Phe Ala Ala Gly Leu Asp Asp

115 120 125

Pro Arg Val Thr Ile Tyr Tyr Gln Asn Gly Leu Arg Phe Leu Arg Asn
130 135 140

Cys Glu Asp Asp Tyr Asp Ile Ile Ile Asn Asp Ala Thr Asp Pro Phe
145 150 155 160

Gly His Thr Glu Gly Leu Phe Thr Lys Glu Phe Tyr Gly Asn Ser Tyr
165 170 175

Arg Ala Leu Lys Glu Asp Gly Ile Met Ile Tyr Gln His Gly Ser Pro
180 185 190

Phe Phe Asp Glu Asp Glu Ser Ala Cys Arg Ser Met His Arg Lys Val
195 200 205

Asn Gln Ala Phe Pro Ile Ser Arg Val Tyr Gln Ala His Ile Pro Thr
210 215 220

Ser Pro Ala Gly Tyr Trp Leu Phe Gly Phe Ala Ser Lys Lys Tyr His
225 230 235 240

Pro Val Lys Asp Phe Asp Lys Glu Gly Trp Lys Lys Arg Gln Leu Phe
245 250 255

Thr Glu Tyr Tyr Thr Ala Asn Leu His Val Gly Ala Phe Met Leu Pro
260 265 270

Lys Tyr Val Glu Asp Ile Leu Glu Glu Glu Glu Gly Lys Lys
275 280 285

<210> 658
<211> 291
<212> PRT
<213> Streptococcus pneumoniae

<400> 658

Met Arg Asn Val Arg Val Ala Thr Ile Gln Met Gln Cys Ala Lys Asp
1 5 10 15

Val Ala Thr Asn Ile Gln Thr Ala Glu Arg Leu Val Arg Gln Ala Ala

20 25 30

Glu Gln Gly Ala Gln Ile Ile Leu Leu Pro Glu Leu Phe Glu His Pro
35 40 45

Tyr Phe Cys Gln Glu Arg Gln Tyr Asp Tyr Tyr Gln Tyr Ala Gln Ser
50 55 60

Val Ala Glu Asn Thr Ala Ile Gln His Phe Lys Val Ile Ala Lys Glu
65 70 75 80

Leu Gln Val Val Leu Pro Ile Ser Phe Tyr Glu Lys Asp Gly Asn Val
85 90 95

Leu Tyr Asn Ser Ile Ala Val Ile Asp Ala Asp Gly Glu Val Leu Gly
100 105 110

Val Tyr Arg Lys Thr His Ile Pro Asp Asp His Tyr Tyr Gln Glu Lys
115 120 125

Phe Tyr Phe Thr Pro Gly Asn Thr Gly Phe Lys Val Trp Asn Thr Arg
130 135 140

Tyr Ala Lys Ile Gly Ile Gly Ile Cys Trp Asp Gln Trp Phe Pro Glu
145 150 155 160

Thr Ala Arg Cys Leu Ala Leu Asn Gly Ala Glu Leu Leu Phe Tyr Pro
165 170 175

Thr Ala Ile Gly Ser Glu Pro Ile Leu Asp Thr Asp Ser Cys Gly His
180 185 190

Trp Gln Arg Thr Met Gln Gly His Ala Ala Ala Asn Ile Val Pro Val
195 200 205

Ile Ala Ala Asn Arg Tyr Gly Leu Glu Glu Val Thr Pro Ser Glu Glu
210 215 220

Asn Gly Gly Gln Ser Ser Ser Leu Asp Phe Tyr Gly Ser Ser Phe Met
225 230 235 240

Thr Asp Glu Thr Gly Ala Ile Leu Glu Arg Ala Glu Arg Gln Glu Glu
245 250 255

Ala Val Leu Leu Ala Thr Tyr Asp Leu Asp Lys Gly Ala Ser Glu Arg
260 265 270

Leu Asn Trp Gly Leu Phe Arg Asp Arg Arg Pro Glu Met Tyr Arg Gln
275 280 285

Ile Thr Asp
290

<210> 659
<211> 119
<212> PRT
<213> Streptococcus pneumoniae

<400> 659

Met Ala Arg Val Lys Gly Gly Val Val Ser Arg Lys Arg Arg Lys Arg
1 5 10 15

Ile Leu Lys Leu Ala Lys Gly Tyr Tyr Gly Ala Lys His Ile Leu Phe
20 25 30

Arg Thr Ala Lys Glu Gln Val Met Asn Ser Tyr Tyr Tyr Ala Tyr Arg
35 40 45

Asp Arg Arg Gln Lys Lys Arg Asp Phe Arg Lys Leu Trp Ile Thr Arg
50 55 60

Ile Asn Ala Ala Ala Arg Met Asn Gly Leu Ser Tyr Ser Gln Leu Met
65 70 75 80

His Gly Leu Lys Leu Ala Glu Ile Glu Val Asn Arg Lys Met Leu Ala
85 90 95

Asp Leu Ala Val Asn Asp Ala Val Ala Phe Thr Ala Leu Ala Asp Ala
100 105 110

Ala Lys Ala Lys Leu Gly Lys
115

<210> 660
<211> 181
<212> PRT
<213> Streptococcus pneumoniae

<400> 660

Met Glu Phe Glu Glu Lys Thr Leu Ser Arg Lys Glu Ile Tyr Gln Gly
1 5 10 15

Pro Ile Phe Lys Leu Val Gln Asp Gln Val Glu Leu Pro Glu Gly Lys
20 25 30

Gly Thr Ala Gln Arg Asp Leu Ile Phe His Asn Gly Ala Val Cys Val
35 40 45

Leu Ala Val Thr Asp Glu Gln Lys Leu Ile Leu Val Lys Gln Tyr Arg
50 55 60

Lys Ala Ile Glu Ala Val Ser Tyr Glu Ile Pro Ala Gly Lys Leu Glu
65 70 75 80

Val Gly Glu Asn Thr Ala Pro Val Ala Ala Ala Leu Arg Glu Leu Glu
85 90 95

Glu Glu Thr Ala Tyr Thr Gly Lys Leu Glu Leu Leu Tyr Asp Phe Tyr
100 105 110

Ser Ala Ile Gly Phe Cys Asn Glu Lys Leu Lys Leu Tyr Leu Ala Ser
115 120 125

Asp Leu Thr Lys Val Glu Asn Pro Arg Pro Gln Asp Glu Asp Glu Thr
130 135 140

Leu Glu Val Leu Glu Val Ser Leu Glu Glu Ala Lys Glu Leu Ile Gln
145 150 155 160

Ser Gly His Ile Cys Asp Ala Lys Thr Ile Met Ala Val Gln Tyr Trp
165 170 175

Glu Leu Gln Lys Lys
180

<210> 661
<211> 191
<212> PRT
<213> Streptococcus pneumoniae

<400> 661

Met Asn Lys Gly Gly Gln Met Lys Lys Val Met Phe Ala Gly Leu Ser
1 5 10 15

Leu Leu Ser Leu Val Val Leu Met Ala Cys Gly Glu Glu Glu Thr Lys
20 25 30

Lys Thr Gln Ala Ala Gln Gln Pro Lys Gln Gln Thr Thr Val Gln Gln
35 40 45

Ile Ala Val Gly Lys Asp Ala Pro Asp Phe Thr Leu Gln Ser Met Asp
50 55 60

Gly Lys Glu Val Lys Leu Ser Asp Phe Lys Gly Lys Lys Val Tyr Leu
65 70 75 80

Lys Phe Trp Ala Ser Trp Cys Gly Pro Cys Lys Lys Ser Met Pro Glu
85 90 95

Leu Met Glu Leu Ala Ala Lys Pro Asp Arg Asp Phe Glu Ile Leu Thr
100 105 110

Val Ile Ala Pro Gly Ile Gln Gly Glu Lys Thr Val Glu Gln Phe Pro
115 120 125

Gln Trp Phe Gln Glu Gln Gly Tyr Lys Asp Ile Pro Val Leu Tyr Asp
130 135 140

Thr Lys Ala Thr Thr Phe Gln Ala Tyr Gln Ile Arg Ser Ile Pro Thr
145 150 155 160

Glu Tyr Leu Ile Asp Ser Gln Gly Lys Ile Gly Lys Ile Gln Phe Gly
165 170 175

Ala Ile Ser Asn Ala Asp Ala Glu Ala Ala Phe Lys Glu Met Asn
180 185 190

<210> 662
<211> 418
<212> PRT
<213> Streptococcus pneumoniae

<400> 662

Met Ile Phe Asp Lys Asp Asp Phe Lys Ala Tyr Asp Ala Asp Leu Trp
1 5 10 15

Asn Ala Ile Ala Lys Glu Glu Glu Arg Gln Gln Asn Asn Ile Glu Leu
20 25 30

Ile Ala Ser Glu Asn Val Val Ser Lys Ala Val Met Ala Ala Gln Gly
35 40 45

Ser Ile Leu Thr Asn Lys Tyr Ala Glu Gly Tyr Pro Gly Arg Arg Tyr
50 55 60

Tyr Gly Gly Thr Asp Val Val Asp Val Val Glu Thr Leu Ala Ile Glu
65 70 75 80

Arg Ala Lys Glu Ile Phe Gly Ala Lys Phe Ala Asn Val Gln Pro His
85 90 95

Ser Gly Ser Gln Ala Asn Cys Ala Ala Tyr Met Ser Leu Ile Glu Pro
100 105 110

Gly Asp Thr Val Met Gly Met Asp Leu Ala Ser Gly Gly His Leu Thr
115 120 125

His Gly Ala Pro Val Ser Phe Ser Gly Gln Thr Tyr Asn Phe Val Ser
130 135 140

Tyr Ser Val Asp Pro Lys Thr Glu Leu Leu Asp Phe Asp Ala Ile Leu
145 150 155 160

Lys Gln Ala Gln Glu Val Lys Pro Lys Leu Ile Val Ala Gly Ala Ser
165 170 175

Ala Tyr Ser Gln Ile Ile Asp Phe Ser Lys Phe Arg Glu Ile Ala Asp
180 185 190

```
Ala Val Gly Ala Lys Leu Met Val Asp Met Ala His Ile Ala Gly Leu
        195                 200                 205

Val Ala Ala Gly Leu His Pro Ser Pro Val Pro Tyr Ala His Ile Thr
    210                 215                 220

Thr Thr Thr Thr His Lys Thr Leu Arg Gly Pro Arg Gly Gly Leu Ile
225                 230                 235                 240

Leu Thr Asn Asp Glu Glu Leu Ala Lys Lys Ile Asn Ser Ala Ile Phe
                245                 250                 255

Pro Gly Ile Gln Gly Gly Pro Leu Glu His Val Val Ala Ala Lys Ala
            260                 265                 270

Val Ser Phe Lys Glu Val Leu Asp Pro Ala Phe Lys Glu Tyr Ala Ala
        275                 280                 285

Asn Val Ile Lys Asn Ser Lys Ala Met Ala Asp Val Phe Leu Gln Asp
    290                 295                 300

Pro Asp Phe Arg Ile Ile Ser Gly Gly Thr Glu Asn His Leu Phe Leu
305                 310                 315                 320

Val Asp Val Thr Lys Val Val Glu Asn Gly Lys Val Ala Gln Asn Leu
                325                 330                 335

Leu Asp Glu Val Asn Ile Thr Leu Asn Lys Asn Ser Ile Pro Tyr Glu
            340                 345                 350

Ser Leu Ser Pro Phe Lys Thr Ser Gly Ile Arg Ile Gly Ala Ala Ala
        355                 360                 365

Ile Thr Ala Arg Gly Phe Gly Glu Glu Glu Ser Arg Lys Val Ala Glu
    370                 375                 380

Leu Ile Ile Lys Thr Leu Lys Asn Ser Glu Asn Glu Ala Val Leu Glu
385                 390                 395                 400

Glu Val Arg Ser Ala Val Lys Glu Leu Thr Asp Ala Phe Pro Leu Tyr
                405                 410                 415
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Glu Asp

<210> 663
<211> 341
<212> PRT
<213> Streptococcus pneumoniae

<400> 663

Met Lys Asn Lys Phe Phe Leu Ile Ala Ile Leu Ala Met Cys Ile Val
1 5 10 15

Phe Ser Ala Cys Ser Ser Asn Ser Val Lys Asn Glu Glu Asn Thr Ser
20 25 30

Lys Glu His Ala Pro Asp Lys Ile Val Leu Asp His Ala Phe Gly Gln
35 40 45

Thr Ile Leu Asp Lys Lys Pro Glu Arg Val Ala Thr Ile Ala Trp Gly
50 55 60

Asn His Asp Val Ala Leu Ala Leu Gly Ile Val Pro Val Gly Phe Ser
65 70 75 80

Lys Ala Asn Tyr Gly Val Ser Ala Asp Lys Gly Val Leu Pro Trp Thr
85 90 95

Glu Glu Lys Ile Lys Glu Leu Asn Gly Lys Ala Asn Leu Phe Asp Asp
100 105 110

Leu Asp Gly Leu Asn Phe Glu Ala Ile Ser Asn Ser Lys Pro Asp Val
115 120 125

Ile Leu Ala Gly Tyr Ser Gly Ile Thr Lys Glu Asp Tyr Asp Thr Leu
130 135 140

Ser Lys Ile Ala Pro Val Ala Ala Tyr Lys Ser Lys Pro Trp Gln Thr
145 150 155 160

Leu Trp Arg Asp Met Ile Lys Ile Asp Ser Lys Ala Leu Gly Met Glu
165 170 175

Lys Glu Gly Asp Glu Leu Ile Lys Asn Thr Glu Ala Arg Ile Ser Lys
180 185 190

Glu Leu Glu Lys His Pro Glu Ile Lys Gly Lys Ile Lys Gly Lys Lys
195 200 205

Val Leu Phe Thr Met Ile Asn Ala Ala Asp Thr Ser Lys Phe Trp Ile
210 215 220

Tyr Thr Ser Lys Asp Pro Arg Ala Asn Tyr Leu Thr Asp Leu Gly Leu
225 230 235 240

Val Phe Pro Glu Ser Leu Lys Glu Phe Glu Ser Glu Asp Ser Phe Ala
245 250 255

Lys Glu Ile Ser Ala Glu Glu Ala Asn Lys Ile Asn Asp Ala Asp Val
260 265 270

Ile Ile Thr Tyr Gly Asp Asp Lys Thr Leu Glu Ala Leu Gln Lys Asp
275 280 285

Pro Leu Leu Gly Lys Ile Asn Ala Ile Lys Asn Gly Ala Val Ala Val
290 295 300

Ile Pro Asp Asn Thr Pro Leu Ala Ala Ser Cys Thr Pro Thr Pro Leu
305 310 315 320

Ser Ile Asn Tyr Thr Ile Glu Glu Tyr Leu Asn Leu Leu Gly Asn Ala
325 330 335

Cys Lys Asn Ala Lys
340

<210> 664
<211> 898
<212> PRT
<213> Streptococcus pneumoniae

<400> 664

Met Ser Leu Gln Lys Leu Glu Asn Tyr Ser Asn Lys Ser Val Val Gln
1 5 10 15

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Glu Glu Val Leu Ile Leu Thr Glu Leu Leu Glu Asp Ile Thr Lys Asn
            20                  25                  30

Met Leu Ala Pro Glu Thr Phe Glu Lys Ile Ile Gln Leu Lys Glu Leu
        35                  40                  45

Ser Thr Gln Glu Asp Tyr Gln Gly Leu Asn Arg Leu Val Thr Ser Leu
    50                  55                  60

Ser Asn Asp Glu Met Val Tyr Ile Ser Arg Tyr Phe Ser Ile Leu Pro
65                  70                  75                  80

Leu Leu Ile Asn Ile Ser Glu Asp Val Asp Leu Ala Tyr Glu Ile Asn
                85                  90                  95

His Gln Asn Asn Ile Asp Gln Asp Tyr Leu Gly Lys Leu Ser Thr Thr
            100                 105                 110

Ile Lys Leu Val Ala Glu Lys Glu Asn Ala Val Glu Ile Leu Glu His
        115                 120                 125

Leu Asn Val Val Pro Val Leu Thr Ala His Pro Thr Gln Val Gln Arg
    130                 135                 140

Lys Ser Met Leu Asp Leu Thr Asn His Ile His Ser Leu Leu Arg Lys
145                 150                 155                 160

Tyr Arg Asp Val Lys Leu Gly Leu Ile Asn Lys Asp Lys Trp Tyr Asn
                165                 170                 175

Asp Leu Arg Arg Tyr Ile Glu Ile Ile Met Gln Thr Asp Met Ile Arg
            180                 185                 190

Glu Lys Lys Leu Lys Val Thr Asn Glu Ile Thr Asn Ala Met Glu Tyr
        195                 200                 205

Tyr Asn Ser Ser Phe Leu Lys Ala Val Pro His Leu Thr Thr Glu Tyr
    210                 215                 220

Lys Arg Leu Ala Gln Ala His Gly Leu Asn Leu Lys Gln Ala Lys Pro
225                 230                 235                 240
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Ile Thr Met Gly Met Trp Ile Gly Gly Asp Arg Asp Gly Asn Pro Phe
245 250 255

Val Thr Ala Lys Thr Leu Lys Gln Ser Ala Leu Thr Gln Cys Glu Val
260 265 270

Ile Met Asn Tyr Tyr Asp Lys Lys Ile Tyr Gln Leu Tyr Arg Glu Phe
275 280 285

Ser Leu Ser Thr Ser Ile Val Asn Val Ser Lys Gln Val Arg Glu Met
290 295 300

Ala Arg Gln Ser Lys Asp Asn Ser Ile Tyr Arg Glu Lys Glu Leu Tyr
305 310 315 320

Arg Arg Ala Leu Phe Asp Ile Gln Ser Lys Ile Gln Ala Thr Lys Thr
325 330 335

Tyr Leu Ile Glu Asp Glu Glu Val Gly Thr Arg Tyr Glu Thr Ala Asn
340 345 350

Asp Phe Tyr Lys Asp Leu Ile Ala Ile Arg Asp Ser Leu Leu Glu Asn
355 360 365

Lys Gly Glu Ser Leu Ile Ser Gly Asp Phe Val Glu Leu Leu Gln Ala
370 375 380

Val Glu Ile Phe Gly Phe Tyr Leu Ala Ser Ile Asp Met Arg Gln Asp
385 390 395 400

Ser Ser Val Tyr Glu Ala Cys Val Ala Glu Leu Leu Lys Ser Ala Gly
405 410 415

Ile His Ser Arg Tyr Ser Glu Leu Ser Glu Glu Glu Lys Cys Asp Leu
420 425 430

Leu Leu Lys Glu Leu Glu Glu Asp Pro Arg Ile Leu Ser Ala Thr His
435 440 445

Ala Glu Lys Ser Glu Leu Leu Ala Lys Glu Leu Ala Ile Phe Lys Thr

450 455 460

Ala Arg Val Leu Lys Asp Lys Leu Gly Asp Asp Val Ile Arg Gln Thr
465 470 475 480

Ile Ile Ser His Ala Thr Ser Leu Ser Asp Met Leu Glu Leu Ala Ile
485 490 495

Leu Leu Lys Glu Val Gly Leu Val Asp Thr Glu Arg Ala Arg Val Gln
500 505 510

Ile Val Pro Leu Phe Glu Thr Ile Glu Asp Leu Asp His Ser Glu Glu
515 520 525

Thr Met Arg Lys Tyr Leu Ser Leu Ser Leu Ala Lys Lys Trp Ile Asp
530 535 540

Ser Arg Asn Asn Tyr Gln Glu Ile Met Leu Gly Tyr Ser Asp Ser Asn
545 550 555 560

Lys Asp Gly Gly Tyr Leu Ser Ser Cys Trp Thr Leu Tyr Lys Ala Gln
565 570 575

Gln Gln Leu Thr Ala Ile Gly Asp Glu Phe Gly Val Lys Val Thr Phe
580 585 590

Phe His Gly Arg Gly Gly Thr Val Gly Arg Gly Gly Gly Pro Thr Tyr
595 600 605

Glu Ala Ile Thr Ser Gln Pro Leu Lys Ser Ile Lys Asp Arg Ile Arg
610 615 620

Leu Thr Glu Gln Gly Glu Val Ile Gly Asn Lys Tyr Gly Asn Lys Asp
625 630 635 640

Ala Ala Tyr Tyr Asn Leu Glu Met Leu Val Ser Ala Ala Ile Asn Arg
645 650 655

Met Ile Thr Gln Lys Lys Ser Asp Thr Asn Thr Pro Asn Arg Tyr Glu
660 665 670

```
Thr Ile Met Asp Gln Val Val Asp Arg Ser Tyr Asp Ile Tyr Arg Asp
        675                 680                 685

Leu Val Phe Gly Asn Glu His Phe Tyr Asp Tyr Phe Phe Glu Ser Ser
    690                 695                 700

Pro Ile Lys Ala Ile Ser Ser Phe Asn Ile Gly Ser Arg Pro Ala Ala
705                 710                 715                 720

Arg Lys Thr Ile Thr Glu Ile Gly Gly Leu Arg Ala Ile Pro Trp Val
                725                 730                 735

Phe Ser Trp Ser Gln Ser Arg Val Met Phe Pro Gly Trp Tyr Gly Val
            740                 745                 750

Gly Ser Ser Phe Lys Glu Phe Ile Asn Lys Asn Pro Glu Asn Ile Ala
        755                 760                 765

Ile Leu Arg Asp Met Tyr Gln Asn Trp Pro Phe Phe Gln Ser Leu Leu
    770                 775                 780

Ser Asn Val Asp Met Val Leu Ser Lys Ser Asn Met Asn Ile Ala Phe
785                 790                 795                 800

Glu Tyr Ala Lys Leu Cys Glu Asp Glu Gln Val Lys Ala Ile Tyr Glu
                805                 810                 815

Thr Ile Leu Asn Glu Trp Gln Val Thr Lys Asn Val Ile Leu Ala Ile
            820                 825                 830

Glu Gly His Asp Glu Leu Leu Ala Asp Asn Pro Tyr Leu Lys Ala Ser
        835                 840                 845

Leu Asp Tyr Arg Met Pro Tyr Phe Asn Ile Leu Asn Tyr Ile Gln Leu
    850                 855                 860

Glu Leu Ile Lys Arg Gln Arg Arg Gly Glu Leu Ser Ser Asp Gln Glu
865                 870                 875                 880

Arg Leu Ile His Ile Thr Ile Asn Gly Ile Ala Thr Gly Leu Arg Asn
                885                 890                 895
```

Ser Gly

<210> 665
<211> 115
<212> PRT
<213> Streptococcus pneumoniae

<400> 665

Met Ala Phe Glu Lys Ile Ile Gln Leu Lys Asn Cys Arg Tyr Asp Tyr
1 5 10 15

Thr Leu Ser Pro Ser Val Lys Lys Phe Thr Leu Lys Asp Asn Thr Phe
20 25 30

Phe Glu Thr Lys Val Gly Asn Tyr Glu Leu Thr Arg Leu Leu Glu Lys
35 40 45

Val Pro Asn Ser Gly Glu Gly Phe Gln Leu Lys Ile Ile Ile Asn Lys
50 55 60

Glu Leu Thr Gly Ala Lys Ile Asn Ile Thr Asp Lys Phe Gly Leu Arg
65 70 75 80

Leu Val Asp Ile Phe Lys Ser Glu Asp His His Ile His Gln Glu Lys
85 90 95

Phe Tyr Phe Leu Met Asp Ser Leu Val Glu Arg Gly Val Phe Thr Lys
100 105 110

Ser Glu Arg
115

<210> 666
<211> 319
<212> PRT
<213> Streptococcus pneumoniae

<400> 666

Met Ser Asp Arg Lys Asn Met Lys Leu Phe Ala Leu Asn Ser Asn Gln
1 5 10 15

Glu Ile Ala Gln Lys Ile Ala Gln Ala Val Gly Val Pro Leu Gly Lys
20 25 30

Leu Ser Ser Arg Gln Phe Ser Asp Gly Glu Ile Gln Val Asn Ile Glu
35 40 45

Glu Ser Val Arg Gly Tyr Asp Val Tyr Ile Ile Gln Ser Thr Ser Phe
50 55 60

Pro Val Asn Asn His Leu Met Glu Leu Leu Ile Met Val Asp Ala Cys
65 70 75 80

Val Arg Ala Ser Ala His Ser Ile Asn Val Val Leu Pro Tyr Phe Gly
85 90 95

Tyr Ala Arg Gln Asp Arg Ile Ala Cys Pro Arg Glu Pro Leu Thr Ala
100 105 110

Lys Leu Val Ala Asn Met Leu Val Lys Ala Gly Val Asp Arg Ile Leu
115 120 125

Thr Leu Asp Leu His Ala Val Gln Val Gln Gly Phe Phe Asp Ile Pro
130 135 140

Val Asp Asn Leu Phe Thr Val Pro Leu Phe Ala Lys His Tyr Cys Asp
145 150 155 160

Lys Gly Leu Leu Gly Ser Asp Val Val Val Val Ser Pro Lys Asn Ser
165 170 175

Gly Val Lys Arg Ala Arg Ser Leu Ala Glu Tyr Leu Asp Ala Pro Ile
180 185 190

Ala Ile Ile Asp Tyr Pro Gln Asp Asp Ala Thr Arg Asn Glu Gly Tyr
195 200 205

Ile Ile Gly Asp Val Glu Gly Lys Lys Ala Ile Leu Ile Asp Asp Ile
210 215 220

Leu Asn Thr Gly Arg Thr Phe Ser Glu Ala Ser Lys Ile Val Glu Arg
225 230 235 240

Glu Gly Ala Thr Glu Ile Tyr Ala Val Ser Ser His Gly Leu Phe Val
245 250 255

Glu Gly Ala Ala Glu Leu Leu Asp Asn Thr Asn Ile Lys Glu Ile Leu
260 265 270

Val Thr Asp Ser Val Ala Thr Lys Glu Lys Thr Pro Lys Asn Val Cys
275 280 285

Tyr Ile Thr Ala Ser Glu Leu Ile Gly Asp Ala Ile Val Arg Ile His
290 295 300

Glu Arg Lys Pro Val Ser Pro Leu Phe Ala Tyr Asn Lys Lys Lys
305 310 315

<210> 667
<211> 474
<212> PRT
<213> Streptococcus pneumoniae

<400> 667

Met Thr Arg Tyr Gln Asn Leu Val Asn Gly Lys Trp Lys Ser Ser Glu
1 5 10 15

Gln Glu Ile Thr Ile Tyr Ser Pro Ile Asn Gln Glu Glu Leu Gly Thr
20 25 30

Val Pro Ala Met Thr Gln Thr Glu Ala Asp Glu Ala Met Gln Ala Ala
35 40 45

Arg Ala Ala Leu Pro Ala Trp Arg Ala Leu Ser Ala Val Glu Arg Ala
50 55 60

Ala Tyr Leu His Lys Thr Ala Ala Ile Leu Glu Arg Asp Lys Glu Glu
65 70 75 80

Ile Gly Thr Ile Leu Ala Lys Glu Val Ala Lys Gly Ile Lys Ala Ala
85 90 95

Ile Gly Glu Val Val Arg Thr Ala Asp Leu Ile Arg Tyr Ala Ala Glu
100 105 110

Glu Gly Leu Arg Ile Thr Gly Gln Ala Met Glu Gly Gly Gly Phe Glu
115 120 125

Ala Thr Ser Lys Asn Lys Leu Ala Val Val Arg Arg Glu Pro Val Gly
130 135 140

Ile Val Leu Ala Ile Ala Pro Phe Asn Tyr Pro Val Asn Leu Ser Ala
145 150 155 160

Ser Lys Ile Ala Pro Ala Leu Ile Ala Gly Asn Val Val Met Phe Lys
165 170 175

Pro Pro Thr Gln Gly Ser Ile Ser Gly Leu Leu Leu Ala Lys Ala Phe
180 185 190

Glu Glu Ala Gly Ile Pro Ala Gly Val Phe Asn Thr Ile Thr Gly Arg
195 200 205

Gly Ser Glu Ile Gly Asp Tyr Ile Ile Glu His Lys Glu Val Asn Phe
210 215 220

Ile Asn Phe Thr Gly Ser Thr Pro Ile Gly Glu Arg Ile Gly Arg Leu
225 230 235 240

Ala Gly Met Arg Pro Ile Met Leu Glu Leu Gly Gly Lys Asp Ala Ala
245 250 255

Leu Val Leu Glu Asp Ala Asp Leu Glu His Ala Ala Lys Gln Ile Val
260 265 270

Ala Gly Ala Phe Ser Tyr Ser Gly Gln Arg Cys Thr Ala Ile Lys Arg
275 280 285

Val Ile Val Leu Glu Ser Val Ala Asp Lys Leu Ala Thr Leu Leu Gln
290 295 300

Glu Glu Val Ser Lys Leu Thr Val Gly Asp Pro Phe Asp Asn Ala Asp
305 310 315 320

Ile Thr Pro Val Ile Asp Asn Ala Ser Ala Asp Phe Ile Trp Gly Leu
325 330 335

Ile Glu Asp Ala Gln Glu Lys Glu Ala Gln Ala Leu Thr Pro Ile Lys
340 345 350

Arg Glu Gly Asn Leu Leu Trp Pro Val Leu Phe Asp Gln Val Thr Lys
355 360 365

Asp Met Lys Val Ala Trp Glu Glu Pro Phe Gly Pro Val Leu Pro Ile
370 375 380

Ile Arg Val Ala Ser Val Glu Glu Ala Ile Ala Phe Ala Asn Glu Ser
385 390 395 400

Glu Phe Gly Leu Gln Ser Ser Val Phe Thr Asn Asp Phe Lys Lys Ala
405 410 415

Phe Glu Ile Ala Glu Lys Leu Glu Val Gly Thr Val His Ile Asn Asn
420 425 430

Lys Thr Gln Arg Gly Pro Asp Asn Phe Pro Phe Leu Gly Val Lys Gly
435 440 445

Ser Gly Ala Gly Val Gln Gly Ile Lys Tyr Ser Ile Glu Ala Met Thr
450 455 460

Asn Val Lys Ser Ile Val Phe Asp Val Lys
465 470

<210> 668
<211> 326
<212> PRT
<213> Streptococcus pneumoniae

<400> 668

Met Ala Leu Thr Glu Gln Lys Arg Val Arg Leu Glu Lys Leu Ser Asp
1 5 10 15

Glu Asn Gly Ile Ile Ser Ala Leu Ala Phe Asp Gln Arg Gly Ala Leu
20 25 30

Lys Arg Leu Met Val Lys His Gln Thr Glu Glu Pro Thr Val Ala Gln
35 40 45

Met Glu Glu Leu Lys Val Leu Val Ala Asp Glu Leu Thr Lys Tyr Ala
50 55 60

Ser Ser Met Leu Leu Asp Pro Glu Tyr Gly Leu Pro Ala Thr Lys Ala
65 70 75 80

Leu Asp Glu Lys Ala Gly Leu Leu Leu Ala Tyr Glu Lys Thr Gly Tyr
85 90 95

Asp Thr Thr Ser Thr Lys Arg Leu Pro Asp Cys Leu Asp Val Trp Ser
100 105 110

Ala Lys Arg Ile Lys Glu Glu Gly Ala Asp Ala Val Lys Phe Leu Leu
115 120 125

Tyr Tyr Asp Val Asp Ser Ser Asp Glu Leu Asn Gln Glu Lys Gln Ala
130 135 140

Tyr Ile Glu Arg Ile Gly Ser Glu Cys Val Ala Glu Asp Ile Pro Phe
145 150 155 160

Phe Leu Glu Ile Leu Ala Tyr Asp Glu Lys Ile Ala Asp Ala Gly Ser
165 170 175

Val Glu Tyr Ala Lys Val Lys Pro His Lys Val Ile Gly Ala Met Lys
180 185 190

Val Phe Ser Asp Pro Arg Phe Asn Ile Asp Val Leu Lys Val Glu Val
195 200 205

Pro Val Asn Ile Lys Tyr Val Glu Gly Phe Ala Glu Gly Glu Val Val
210 215 220

Tyr Thr Arg Glu Glu Ala Ala Ala Phe Phe Lys Ala Gln Asp Glu Ala
225 230 235 240

Thr Asn Leu Pro Tyr Ile Tyr Leu Ser Ala Gly Val Ser Ala Lys Leu
245 250 255

Phe Gln Asp Thr Leu Val Phe Ala His Glu Ser Gly Ala Asn Phe Asn

260 265 270

Gly Val Leu Cys Gly Arg Ala Thr Trp Ala Gly Ser Val Glu Ala Tyr
275 280 285

Ile Lys Asp Gly Glu Ala Ala Ala Arg Glu Cys Val Arg Thr Thr Gly
290 295 300

Phe Glu Asn Ile Asp Glu Leu Asn Lys Val Leu Gln Arg Thr Ala Thr
305 310 315 320

Ser Trp Lys Glu Arg Val
325

<210> 669
<211> 171
<212> PRT
<213> Streptococcus pneumoniae

<400> 669

Met Arg Ile Ala Ile Gly Cys Asp His Ile Val Thr Asp Glu Lys Met
1 5 10 15

Ala Val Ser Glu Phe Leu Lys Ser Lys Gly Tyr Glu Val Ile Asp Phe
20 25 30

Gly Thr Tyr Asp His Thr Arg Thr His Tyr Pro Ile Phe Gly Lys Lys
35 40 45

Val Gly Glu Ala Val Thr Ser Gly Gln Ala Asp Leu Gly Val Cys Ile
50 55 60

Cys Gly Thr Gly Val Gly Ile Asn Asn Ala Val Asn Lys Val Pro Gly
65 70 75 80

Val Arg Ser Ala Leu Val Arg Asp Met Thr Thr Ala Leu Tyr Ala Lys
85 90 95

Glu Gln Leu Asn Ala Asn Val Ile Gly Phe Gly Gly Lys Ile Thr Gly
100 105 110

Glu Leu Leu Met Cys Asp Ile Ile Glu Ala Phe Ile His Ala Glu Tyr

115 120 125

Lys Pro Thr Glu Glu Asn Lys Lys Leu Ile Ala Lys Ile Glu His Val
130 135 140

Glu Ser His Asn Ala Gln Gln Thr Asp Ala Asn Phe Phe Thr Glu Phe
145 150 155 160

Leu Glu Lys Trp Asp Arg Gly Glu Tyr His Asp
165 170

<210> 670
<211> 141
<212> PRT
<213> Streptococcus pneumoniae

<400> 670

Met Ser Ile Val Ile Gly Ala Asp Ala Ala Gly Leu Arg Leu Lys Glu
1 5 10 15

Val Val Lys Asp Phe Leu Glu Lys Glu Asn Phe His Leu Val Asp Val
20 25 30

Thr Ala Glu Gly Gln Asp Phe Val Asp Val Thr Leu Ala Val Ala Ala
35 40 45

Glu Val Asn Lys Glu Glu Gln Asn Leu Gly Ile Val Ile Asp Ala Tyr
50 55 60

Gly Ala Gly Pro Phe Ile Val Ala Thr Lys Ile Lys Gly Met Val Ala
65 70 75 80

Ala Glu Val Ser Asp Glu Arg Ser Ala Tyr Met Thr Arg Gly His Asn
85 90 95

Asn Ser Arg Met Ile Thr Met Gly Ala Gln Leu Val Gly Asp Glu Leu
100 105 110

Ala Lys Asn Ile Ala Lys Gly Phe Val Asn Gly Lys Tyr Asp Gly Gly
115 120 125

Arg His Gln Ile Arg Val Asp Met Leu Asn Lys Met Gly

130 135 140

<210> 671
<211> 628
<212> PRT
<213> Streptococcus pneumoniae

<400> 671

Met Val Leu Ser Lys Tyr Gln Lys Gln Phe Ile Ile Asn Arg Tyr Pro
1 5 10 15

Glu Arg Lys Arg Ile Met Asn Leu Glu Glu Leu Lys Lys Arg Gln Glu
20 25 30

Lys Ile Arg Asn Phe Ser Ile Ile Ala His Ile Asp His Gly Lys Ser
35 40 45

Thr Leu Ala Asp Arg Ile Leu Glu Lys Thr Glu Thr Val Ser Ser Arg
50 55 60

Glu Met Gln Ala Gln Leu Leu Asp Ser Met Glu Leu Glu Arg Glu Arg
65 70 75 80

Gly Ile Thr Ile Lys Leu Asn Ala Ile Glu Leu Asn Tyr Thr Ala Lys
85 90 95

Asp Gly Glu Thr Tyr Ile Phe His Leu Ile Asp Thr Pro Gly His Val
100 105 110

Asp Phe Thr Tyr Glu Val Ser Arg Ser Leu Ala Ala Cys Glu Gly Ala
115 120 125

Ile Leu Val Val Asp Ala Ala Gln Gly Ile Glu Ala Gln Thr Leu Ala
130 135 140

Asn Val Tyr Leu Ala Leu Asp Asn Asp Leu Glu Ile Met Pro Ile Ile
145 150 155 160

Asn Lys Ile Asp Leu Pro Ala Ala Asp Pro Glu Arg Val Arg Thr Glu
165 170 175

Ile Glu Asp Val Ile Gly Leu Asp Ala Ser Glu Ala Val Leu Ala Ser

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            180                     185                     190

Ala Lys Ala Gly Ile Gly Ile Glu Glu Ile Leu Glu Gln Ile Val Glu
        195                     200                     205

Lys Val Pro Ala Pro Thr Gly Asp Val Thr Ala Pro Leu Lys Ala Leu
    210                     215                     220

Ile Phe Asp Ser Val Tyr Asp Ala Tyr Arg Gly Val Ile Leu Gln Val
225                     230                     235                     240

Arg Val Met Asp Gly Val Val Lys Pro Gly Asp Lys Ile Gln Leu Met
                245                     250                     255

Ser Asn Ser Lys Thr Phe Asp Val Ala Glu Val Gly Ile Phe Thr Pro
            260                     265                     270

Lys Ala Val Gly Arg Asp Phe Leu Ala Thr Gly Asp Val Gly Tyr Ile
        275                     280                     285

Ala Ala Ser Ile Lys Thr Val Gln Asp Thr Arg Val Gly Asp Thr Val
    290                     295                     300

Thr Leu Ala Thr Asn Pro Ala Ala Glu Pro Leu His Gly Tyr Lys Gln
305                     310                     315                     320

Met Asn Pro Met Val Phe Ala Gly Leu Tyr Pro Ile Glu Ser Asn Lys
                325                     330                     335

Tyr Asn Asp Leu Arg Glu Ala Leu Glu Lys Leu Gln Leu Asn Asp Ala
            340                     345                     350

Ser Leu Gln Phe Glu Pro Glu Thr Ser Gln Ala Leu Gly Phe Gly Phe
        355                     360                     365

Arg Cys Gly Phe Leu Gly Leu Leu His Met Asp Val Ile Gln Glu Arg
    370                     375                     380

Leu Glu Arg Glu Phe Asn Ile Asp Leu Ile Met Thr Ala Pro Ser Val
385                     390                     395                     400
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Ile Tyr Lys Val Asn Leu Thr Asp Gly Glu Ser Met Asp Val Ser Asn
                405                 410                 415

Pro Ser Glu Phe Pro Asp Pro Thr Lys Ile Ala Thr Ile Glu Glu Pro
            420                 425                 430

Tyr Val Lys Ala Gln Ile Met Val Pro Gln Glu Phe Val Gly Ala Val
        435                 440                 445

Met Glu Leu Ala Gln Arg Lys Arg Gly Asp Phe Val Thr Met Asp Tyr
    450                 455                 460

Ile Asp Asp Asn Arg Val Asn Val Ile Tyr Gln Ile Pro Leu Ala Glu
465                 470                 475                 480

Ile Val Phe Asp Phe Phe Asp Lys Leu Lys Ser Ser Thr Arg Gly Tyr
                485                 490                 495

Ala Ser Phe Asp Tyr Glu Leu Ser Glu Tyr Arg Pro Ser Lys Leu Val
            500                 505                 510

Lys Met Asp Ile Leu Leu Asn Gly Asp Lys Val Asp Ala Leu Ser Phe
        515                 520                 525

Ile Val His Lys Asp Phe Ala Tyr Glu Arg Gly Lys Leu Ile Val Asp
    530                 535                 540

Lys Leu Lys Lys Ile Ile Pro Arg Gln Gln Phe Glu Val Pro Ile Gln
545                 550                 555                 560

Ala Ala Ile Gly His Lys Ile Val Ala Arg Thr Asp Ile Lys Ala Leu
                565                 570                 575

Arg Lys Asn Val Leu Ala Lys Cys Tyr Gly Gly Asp Val Ser Arg Lys
            580                 585                 590

Arg Lys Leu Leu Glu Lys Gln Lys Ala Gly Lys Lys Arg Met Lys Ser
        595                 600                 605

Ile Gly Ser Val Glu Val Pro Gln Glu Ala Phe Leu Ser Val Leu Ser
    610                 615                 620
```

Met Asp Glu Glu
625

<210> 672
<211> 448
<212> PRT
<213> Streptococcus pneumoniae

<400> 672

Met Glu Met Glu Lys Tyr Leu Ser Val Thr Thr Leu Thr Lys Tyr Leu
1 5 10 15

Lys Met Lys Phe Asp Lys Asp Pro Tyr Leu Glu Arg Val Tyr Leu Thr
20 25 30

Gly Gln Val Ser Asn Phe Arg Lys Arg Pro Thr His Gln Tyr Phe Ser
35 40 45

Leu Lys Asp Asp His Ala Val Ile Gln Ala Thr Ile Trp Ser Gly Ile
50 55 60

Tyr Gln Lys Leu Gly Phe Asp Leu Glu Glu Gly Met Lys Ile Asn Val
65 70 75 80

Ile Gly Arg Val Gln Val Tyr Glu Pro Ser Gly Ser Tyr Ser Ile Ile
85 90 95

Ile Glu Lys Ala Glu Pro Asp Gly Val Gly Ala Leu Ala Ile Gln Phe
100 105 110

Glu Gln Leu Lys Lys Lys Leu Thr Glu Glu Gly Leu Phe Gln Glu Arg
115 120 125

Phe Lys Gln Ala Leu Pro Gln Phe Ser Lys Arg Ile Gly Val Val Thr
130 135 140

Ser Arg Ser Gly Ala Val Ile Arg Asp Ile Ile Thr Thr Val Ser Arg
145 150 155 160

Arg Phe Pro Gly Val Asp Ile Leu Leu Tyr Pro Thr Lys Val Gln Gly
165 170 175

```
Glu Gly Ala Ala Glu Glu Ile Ala Arg Asn Ile Ala Arg Ala Asn Gln
            180                 185                 190

Arg Asp Asp Leu Asp Leu Leu Ile Ile Gly Arg Gly Gly Gly Ser Ile
        195                 200                 205

Glu Asp Leu Trp Ala Phe Asn Glu Glu Ile Val Val Arg Ala Ile Phe
    210                 215                 220

Glu Ser Arg Leu Pro Val Ile Ser Ser Val Gly His Glu Thr Asp Val
225                 230                 235                 240

Thr Leu Ala Asp Phe Val Ala Asp Arg Arg Ala Ala Thr Pro Thr Ala
                245                 250                 255

Ala Ala Glu Leu Ala Thr Pro Val Thr Lys Leu Asp Val Leu Ala His
            260                 265                 270

Leu Gln Asn Gln Glu Lys Arg Met Val Thr Ala Val Arg Asn Val Leu
        275                 280                 285

Ser Lys Lys Gln Glu Ala Leu Lys Lys Cys Ser Gln Ser Val Ile Phe
    290                 295                 300

Arg Gln Pro Glu Arg Leu Tyr Asp Gly Tyr Leu Gln Arg Leu Asp Gln
305                 310                 315                 320

Leu Gln Leu Arg Leu Lys Gln Ser Leu Arg Thr Arg Ile Ser Asp Asn
                325                 330                 335

Lys Gln Leu Val Gln Ala Arg Thr His Gln Leu Val Gln Leu Ser Pro
            340                 345                 350

Val Thr Lys Ile Gln Arg Tyr Gln Asp Arg Leu Gly Gln Leu Asp Lys
        355                 360                 365

Leu Leu Gly Ser Gln Met Ala Leu Val Tyr Asp Ala Lys Val Ala Glu
    370                 375                 380

Ala Lys Arg Leu Ser Glu Ala Leu Leu Met Leu Asp Thr Ser Arg Ile
385                 390                 395                 400
```

Val Ala Arg Gly Tyr Ala Ile Val Lys Lys Glu Glu Ser Val Val Asp
405 410 415

Ser Val Glu Ser Leu Lys Lys Lys Asp Gln Val Thr Leu Leu Met Arg
420 425 430

Asp Gly Gln Val Glu Leu Glu Val Lys Asp Val Lys Thr Lys Glu Ile
435 440 445

<210> 673
<211> 247
<212> PRT
<213> Streptococcus pneumoniae

<400> 673

Met Ser Gln Lys Asn Asn Lys Lys Lys Asn Lys Arg Lys Asn Leu Leu
1 5 10 15

Thr Asn Ile Leu Ala Gly Phe Leu Ile Leu Leu Ser Leu Ala Leu Ile
20 25 30

Phe Asn Thr Gln Ile Arg Asn Ile Phe Ile Val Trp Asn Thr Asn Lys
35 40 45

Tyr Gln Val Ser Gln Val Ser Lys Glu Lys Leu Glu Glu Asn Gln Asp
50 55 60

Thr Glu Gly Asn Phe Asp Phe Asp Ser Val Lys Ala Ile Ser Ser Glu
65 70 75 80

Ala Val Leu Thr Ser Gln Trp Asp Ala Gln Lys Leu Pro Val Ile Gly
85 90 95

Gly Ile Ala Ile Pro Glu Leu Glu Met Asn Leu Pro Ile Phe Lys Gly
100 105 110

Leu Asp Asn Val Asn Leu Phe Tyr Gly Ala Gly Thr Met Lys Arg Glu
115 120 125

Gln Val Met Gly Glu Gly Asn Tyr Ser Leu Ala Ser His His Ile Phe
130 135 140

Gly Val Asp Asn Ala Asn Lys Met Leu Phe Ser Pro Leu Asp Asn Ala
145 150 155 160

Lys Asn Gly Met Lys Ile Tyr Leu Thr Asp Lys Asn Lys Val Tyr Thr
165 170 175

Tyr Glu Ile Arg Glu Val Lys Arg Val Thr Pro Asp Arg Val Asp Glu
180 185 190

Val Asp Asp Arg Asp Gly Val Asn Glu Ile Thr Leu Val Thr Cys Glu
195 200 205

Asp Leu Ala Ala Thr Glu Arg Ile Ile Val Lys Gly Asp Leu Lys Glu
210 215 220

Thr Lys Asp Tyr Ser Gln Thr Ser Asn Glu Ile Leu Thr Ala Phe Asn
225 230 235 240

Gln Pro Tyr Lys Gln Phe Tyr
245

<210> 674
<211> 332
<212> PRT
<213> Streptococcus pneumoniae

<400> 674

Met Phe Lys Thr Met Thr Ser Thr Lys Gln His Lys Lys Val Ile Leu
1 5 10 15

Val Gly Asp Gly Ala Val Gly Ser Ser Tyr Ala Phe Ala Leu Val Asn
20 25 30

Gln Gly Ile Ala Gln Glu Leu Gly Ile Ile Glu Ile Pro Gln Leu His
35 40 45

Glu Lys Ala Val Gly Asp Ala Leu Asp Leu Ser His Ala Leu Ala Phe
50 55 60

Thr Ser Pro Lys Lys Ile Tyr Ala Ala Gln Tyr Ser Asp Cys Ala Asp
65 70 75 80

Ala Asp Leu Val Val Ile Thr Ala Gly Ala Pro Gln Lys Pro Gly Glu
85 90 95

Thr Arg Leu Asp Leu Val Gly Lys Asn Leu Ala Ile Asn Lys Ser Ile
100 105 110

Val Thr Gln Val Val Glu Ser Gly Phe Lys Gly Ile Phe Leu Val Ala
115 120 125

Ala Asn Pro Val Asp Val Leu Thr Tyr Ser Thr Trp Lys Phe Ser Gly
130 135 140

Phe Pro Lys Glu Arg Val Ile Gly Ser Gly Thr Ser Leu Asp Ser Ala
145 150 155 160

Arg Phe Arg Gln Ala Leu Ala Glu Lys Leu Asp Val Asp Ala Arg Ser
165 170 175

Val His Ala Tyr Ile Met Gly Glu His Gly Asp Ser Glu Phe Ala Val
180 185 190

Trp Ser His Ala Asn Ile Ala Gly Val Asn Leu Glu Glu Phe Leu Lys
195 200 205

Asp Thr Gln Asn Val Gln Glu Ala Glu Leu Ile Glu Leu Phe Glu Gly
210 215 220

Val Arg Asp Ala Ala Tyr Thr Ile Ile Asn Lys Lys Gly Ala Thr Tyr
225 230 235 240

Tyr Gly Ile Ala Val Ala Leu Ala Arg Ile Thr Lys Ala Ile Leu Asp
245 250 255

Asp Glu Asn Ala Val Leu Pro Leu Ser Val Phe Gln Glu Gly Gln Tyr
260 265 270

Gly Val Glu Asn Val Phe Ile Gly Gln Pro Ala Val Val Gly Ala His
275 280 285

Gly Ile Val Arg Pro Val Asn Ile Pro Leu Asn Asp Ala Glu Thr Gln

290 295 300

Lys Met Gln Ala Ser Ala Lys Glu Leu Gln Ala Ile Ile Asp Glu Ala
305 310 315 320

Trp Lys Asn Pro Glu Phe Gln Glu Ala Ser Lys Asn
325 330

<210> 675
<211> 183
<212> PRT
<213> Streptococcus pneumoniae

<400> 675

Met Ala Asn Ile Leu Leu Ala Val Thr Gly Ser Ile Ala Ser Tyr Lys
1 5 10 15

Ser Ala Asp Leu Val Ser Ser Leu Lys Lys Gln Gly His Gln Val Thr
20 25 30

Val Leu Met Thr Gln Ala Ala Thr Glu Phe Ile Gln Pro Leu Thr Leu
35 40 45

Gln Val Leu Ser Gln Asn Pro Val His Leu Asp Val Met Lys Glu Pro
50 55 60

Tyr Pro Asp Gln Val Asn His Ile Glu Leu Gly Lys Lys Ala Asp Leu
65 70 75 80

Phe Ile Val Val Pro Ala Thr Ala Asn Thr Ile Ala Lys Leu Ala His
85 90 95

Gly Phe Ala Asp Asn Met Val Thr Ser Thr Ala Leu Ala Leu Pro Ser
100 105 110

His Ile Pro Lys Leu Ile Ala Pro Ala Met Asn Thr Lys Met Tyr Asp
115 120 125

His Pro Val Thr Gln Asn Asn Leu Lys Thr Leu Glu Thr Tyr Gly Tyr
130 135 140

Gln Leu Ile Ala Pro Lys Glu Ser Leu Leu Ala Cys Gly Asp His Gly

145 150 155 160

Arg Gly Ala Leu Ala Asp Leu Thr Ile Ile Leu Glu Arg Ile Lys Glu
165 170 175

Thr Ile Asp Glu Lys Thr Leu
180

<210> 676
<211> 289
<212> PRT
<213> Streptococcus pneumoniae

<400> 676

Met Glu Lys Ile Ile Lys Glu Lys Ile Ser Ser Leu Leu Ser Gln Glu
1 5 10 15

Glu Glu Val Leu Ser Val Glu Gln Leu Gly Gly Met Thr Asn Gln Asn
20 25 30

Tyr Leu Ala Lys Thr Thr Asn Lys Gln Tyr Ile Val Lys Phe Phe Gly
35 40 45

Lys Gly Thr Glu Lys Leu Ile Asn Arg Gln Asp Glu Lys Tyr Asn Leu
50 55 60

Glu Leu Leu Lys Asp Leu Gly Leu Asp Val Lys Asn Tyr Leu Phe Asp
65 70 75 80

Ile Glu Ala Gly Ile Lys Val Asn Glu Tyr Ile Glu Ser Ala Ile Thr
85 90 95

Leu Asp Ser Thr Ser Ile Lys Thr Lys Phe Asp Lys Ile Thr Pro Ile
100 105 110

Leu Gln Thr Ile His Thr Ser Ala Lys Glu Leu Arg Gly Glu Phe Ala
115 120 125

Pro Phe Glu Glu Ile Lys Lys Tyr Glu Ser Leu Ile Glu Glu Gln Ile
130 135 140

Pro Tyr Ala Asn Tyr Glu Ser Val Arg Asn Ala Val Phe Ser Leu Glu

145 150 155 160

Lys Arg Leu Ala Asp Leu Gly Val Asp Arg Lys Ser Cys His Ile Asp
165 170 175

Leu Val Pro Glu Asn Phe Ile Glu Ser Pro Gln Gly Arg Leu Tyr Leu
180 185 190

Ile Asp Trp Glu Tyr Ser Ser Met Asn Asp Pro Met Trp Asp Leu Ala
195 200 205

Ala Leu Phe Leu Glu Ser Glu Phe Thr Ser Gln Glu Glu Glu Thr Phe
210 215 220

Leu Ser His Tyr Glu Ser Asp Gln Thr Pro Val Ser His Glu Lys Ile
225 230 235 240

Ala Ile Tyr Lys Ile Leu Gln Asp Thr Ile Trp Ser Leu Trp Thr Val
245 250 255

Tyr Lys Glu Glu Gln Gly Glu Asp Phe Gly Asp Tyr Gly Val Asn Arg
260 265 270

Tyr Gln Arg Ala Ile Lys Gly Leu Ala Ser Tyr Gly Gly Ser Asp Glu
275 280 285

Lys

<210> 677
<211> 267
<212> PRT
<213> Streptococcus pneumoniae

<400> 677

Met Lys Gln Leu Thr Val Glu Asp Ala Lys Gln Ile Glu Leu Glu Ile
1 5 10 15

Leu Asp Tyr Ile Asp Thr Leu Cys Lys Lys His Asn Ile Asn Tyr Ile
20 25 30

Ile Asn Tyr Gly Thr Leu Ile Gly Ala Val Arg His Glu Gly Phe Ile

35 40 45

Pro Trp Asp Asp Asp Ile Asp Leu Ser Met Pro Arg Glu Asp Tyr Gln
50 55 60

Arg Phe Ile Asn Ile Phe Gln Lys Glu Lys Ser Lys Tyr Lys Leu Leu
65 70 75 80

Ser Leu Glu Thr Asp Lys Asn Tyr Phe Asn Asn Phe Ile Lys Ile Thr
85 90 95

Asp Ser Thr Thr Lys Ile Ile Asp Thr Arg Asn Thr Lys Thr Tyr Glu
100 105 110

Ser Gly Ile Phe Ile Asp Ile Phe Pro Ile Asp Arg Phe Asp Asp Pro
115 120 125

Lys Val Ile Asp Thr Cys Tyr Lys Leu Glu Ser Phe Lys Leu Leu Ser
130 135 140

Phe Ser Lys His Lys Asn Ile Val Tyr Lys Asp Ser Leu Leu Lys Asp
145 150 155 160

Trp Ile Arg Thr Ala Phe Trp Leu Leu Leu Arg Pro Val Ser Pro Arg
165 170 175

Tyr Phe Ala Asn Lys Ile Glu Lys Glu Ile Gln Lys Tyr Ser Arg Glu
180 185 190

Asn Gly Gln Tyr Met Ala Phe Ile Pro Ser Lys Phe Lys Glu Lys Glu
195 200 205

Val Phe Pro Ser Gly Thr Phe Asp Lys Thr Ile Asp Leu Pro Phe Glu
210 215 220

Asn Leu Ser Leu Pro Ala Pro Glu Lys Phe Asp Thr Ile Leu Thr Gln
225 230 235 240

Phe Tyr Gly Asp Tyr Met Thr Leu Pro Pro Glu Glu Lys Arg Phe Tyr
245 250 255

Ser His Glu Phe His Ala Tyr Lys Leu Glu Asp
260 265

<210> 678
<211> 115
<212> PRT
<213> Streptococcus pneumoniae

<400> 678

Met Asn Pro Leu Ile Gln Ser Leu Thr Glu Gly Gln Leu Arg Thr Asp
1 5 10 15

Ile Pro Ser Phe Arg Pro Gly Asp Thr Val Arg Val His Ala Lys Val
20 25 30

Val Glu Gly Asn Arg Glu Arg Ile Gln Ile Phe Glu Gly Val Val Ile
35 40 45

Ala Arg Lys Gly Ala Gly Ile Ser Glu Asn Tyr Thr Val Arg Lys Ile
50 55 60

Ser Asn Gly Val Gly Val Glu Arg Ile Phe Pro Ile His Thr Pro Arg
65 70 75 80

Val Glu Lys Ile Glu Val Val Arg Tyr Gly Lys Val Arg Arg Ala Lys
85 90 95

Leu Tyr Tyr Leu Arg Ala Leu Gln Gly Lys Ala Ala Arg Ile Lys Glu
100 105 110

Ile Arg Arg
115

<210> 679
<211> 147
<212> PRT
<213> Streptococcus pneumoniae

<400> 679

Met Ala Leu Ala Lys Ile Val Phe Ala Ser Met Thr Gly Asn Thr Glu
1 5 10 15

Glu Ile Ala Asp Ile Val Ala Asp Lys Leu Arg Asp Leu Gly Leu Asp

20 25 30

Val Asp Val Asp Glu Cys Thr Thr Val Asp Ala Ser Asp Phe Leu Glu
35 40 45

Ala Asp Ile Ala Ile Val Ala Thr Tyr Thr Tyr Gly Asp Gly Glu Leu
50 55 60

Pro Asp Glu Met Met Asp Phe Tyr Glu Asp Leu Ala Asp Leu Asn Leu
65 70 75 80

Asn Gly Lys Ile Tyr Gly Val Val Gly Ser Gly Asp Thr Phe Tyr Asp
85 90 95

Glu Phe Cys Lys Ala Val Asp Asp Phe Asp Arg Val Phe Val Ser Thr
100 105 110

Gly Ala Glu Lys Gly Ser Glu Cys Val Lys Val Asp Leu Ser Ala Glu
115 120 125

Glu Glu Asp Ile Glu Arg Leu Glu Gln Phe Ala Glu Glu Leu Ala Ala
130 135 140

Lys Val Gly
145

<210> 680
<211> 127
<212> PRT
<213> Streptococcus pneumoniae

<400> 680

Met Glu Glu Ile Thr Met Ala Leu Asn Ile Glu Asn Ile Ile Ala Glu
1 5 10 15

Ile Lys Glu Ala Ser Ile Leu Glu Leu Asn Asp Leu Val Lys Ala Ile
20 25 30

Glu Glu Glu Phe Gly Val Thr Ala Ala Ala Pro Val Ala Val Ala Ala
35 40 45

Ala Asp Ala Ala Asp Ala Gly Ala Ala Lys Asp Ser Phe Asp Val Glu

50 55 60

Leu Thr Ser Ala Gly Asp Lys Lys Val Gly Val Ile Lys Val Val Arg
65 70 75 80

Glu Ile Thr Gly Leu Gly Leu Lys Glu Ala Lys Glu Leu Val Asp Gly
85 90 95

Ala Pro Ala Leu Val Lys Glu Gly Val Ala Thr Ala Glu Ala Glu Glu
100 105 110

Ile Lys Ala Lys Leu Glu Glu Ala Gly Ala Ser Val Thr Leu Lys
115 120 125

<210> 681
<211> 170
<212> PRT
<213> Streptococcus pneumoniae

<400> 681

Met Asn Thr Leu Met Ser Glu Ala Ile Ile Ala Lys Lys Ala Glu Leu
1 5 10 15

Val Asp Val Val Ala Glu Lys Met Lys Ala Ala Ala Ser Ile Val Val
20 25 30

Val Asp Ala Arg Gly Leu Thr Val Glu Gln Asp Thr Val Leu Arg Arg
35 40 45

Glu Leu Arg Gly Ser Glu Val Glu Tyr Lys Val Ile Lys Asn Ser Ile
50 55 60

Leu Arg Arg Ala Ala Glu Lys Ala Gly Leu Glu Asp Leu Ala Ser Val
65 70 75 80

Phe Val Gly Pro Ser Ala Val Ala Phe Ser Asn Glu Asp Val Ile Ala
85 90 95

Pro Ala Lys Ile Leu Asn Asp Phe Ser Lys Asn Ala Glu Ala Leu Glu
100 105 110

Ile Lys Gly Gly Ala Ile Glu Gly Ala Val Ala Ser Lys Glu Glu Ile

115 120 125

Leu Ala Leu Ala Thr Leu Pro Asn Arg Glu Gly Leu Leu Ser Met Leu
130 135 140

Leu Ser Val Leu Gln Ala Pro Val Arg Asn Val Ala Leu Ala Val Lys
145 150 155 160

Ala Val Ala Glu Ser Lys Glu Asp Ala Ala
165 170

<210> 682
<211> 596
<212> PRT
<213> Streptococcus pneumoniae

<400> 682

Met Lys Ser Met His Pro Asn Met Glu Arg Arg Thr Arg Met Lys Arg
1 5 10 15

Gln Thr Val Asn Gln Thr Leu Lys Arg Leu Ala Val Asp Leu Ala Ser
20 25 30

His Pro Phe Leu Leu Phe Leu Ala Phe Leu Gly Thr Ile Ala Gln Val
35 40 45

Gly Leu Ser Ile Tyr Leu Pro Ile Leu Ile Gly Gln Val Ile Asp Gln
50 55 60

Val Leu Val Ala Gly Ser Ser Pro Val Phe Trp Gln Ile Phe Leu Gln
65 70 75 80

Met Leu Leu Val Val Ile Gly Asn Thr Leu Val Gln Trp Ala Asn Pro
85 90 95

Leu Leu Tyr Asn Arg Leu Ile Phe Ser Tyr Thr Arg Asp Leu Arg Glu
100 105 110

Arg Ile Ile His Lys Leu His Arg Leu Pro Ile Ala Phe Val Asp Arg
115 120 125

Gln Gly Ser Gly Glu Met Val Ser Arg Val Thr Thr Asp Ile Glu Gln

130 135 140

Leu Ala Ala Gly Leu Thr Met Ile Phe Asn Gln Phe Phe Ile Gly Val
145 150 155 160

Leu Met Ile Leu Val Ser Ile Leu Ala Met Leu Gln Ile His Leu Leu
165 170 175

Met Thr Leu Leu Val Leu Leu Leu Thr Pro Leu Ser Met Val Ile Ser
180 185 190

Arg Phe Ile Ala Lys Lys Ser Tyr His Leu Phe Gln Lys Gln Thr Glu
195 200 205

Thr Arg Gly Ile Gln Thr Gln Leu Ile Glu Glu Ser Leu Ser Gln Gln
210 215 220

Thr Ile Ile Gln Ser Phe Asn Ala Gln Thr Glu Phe Ile Gln Arg Leu
225 230 235 240

Arg Glu Ala His Asp Asn Tyr Ser Gly Tyr Ser Gln Ser Ala Ile Phe
245 250 255

Tyr Ser Ser Thr Val Asn Pro Ser Thr Arg Phe Val Asn Ala Leu Ile
260 265 270

Tyr Ala Leu Leu Ala Gly Val Gly Ala Tyr Arg Ile Met Met Gly Ser
275 280 285

Ala Leu Thr Val Gly Arg Leu Val Thr Phe Leu Asn Tyr Val Gln Gln
290 295 300

Tyr Thr Lys Pro Phe Asn Asp Ile Ser Ser Val Leu Ala Glu Leu Gln
305 310 315 320

Ser Ala Leu Ala Cys Val Glu Arg Ile Tyr Gly Val Leu Asp Ser Pro
325 330 335

Glu Val Ala Glu Thr Gly Lys Glu Val Leu Thr Thr Ser Asp Gln Val
340 345 350

Lys Gly Ala Ile Ser Phe Lys His Val Ser Phe Gly Tyr His Pro Glu
355 360 365

Lys Ile Leu Ile Lys Asp Leu Ser Ile Asp Ile Pro Ala Gly Ser Lys
370 375 380

Val Ala Ile Val Gly Pro Thr Gly Ala Gly Lys Ser Thr Leu Ile Asn
385 390 395 400

Leu Leu Met Arg Phe Tyr Pro Ile Ser Ser Gly Asp Ile Leu Leu Asp
405 410 415

Gly Gln Ser Ile Tyr Asp Tyr Thr Arg Val Ser Leu Arg Gln Gln Phe
420 425 430

Gly Met Val Leu Gln Glu Thr Trp Leu Thr Gln Gly Thr Ile His Asp
435 440 445

Asn Ile Ala Phe Gly Asn Pro Glu Ala Ser Arg Glu Gln Val Ile Ala
450 455 460

Ala Ala Lys Ala Ala Asn Ala Asp Phe Phe Ile Gln Gln Leu Pro Gln
465 470 475 480

Gly Tyr Asp Thr Lys Leu Glu Asn Ala Gly Glu Ser Leu Ser Val Gly
485 490 495

Gln Ala Gln Leu Leu Thr Ile Ala Arg Val Phe Leu Ala Ile Pro Lys
500 505 510

Ile Leu Ile Leu Asp Glu Ala Thr Ser Ser Ile Asp Thr Arg Thr Glu
515 520 525

Val Leu Val Gln Asp Ala Phe Ala Lys Leu Met Lys Gly Arg Thr Ser
530 535 540

Phe Ile Ile Ala His Arg Leu Ser Thr Ile Gln Asp Ala Asp Leu Ile
545 550 555 560

Leu Val Leu Val Asp Gly Asp Ile Val Glu Tyr Gly Asn His Gln Glu
565 570 575

Leu Met Asp Arg Lys Gly Lys Tyr Tyr Gln Met Gln Lys Ala Ala Ala
580 585 590

Phe Ser Ser Glu
595

<210> 683
<211> 344
<212> PRT
<213> Streptococcus pneumoniae

<400> 683

Met Phe Glu His Tyr Ser Val Ala Asp Leu Phe Ala Asn Leu Tyr Lys
1 5 10 15

Lys Arg Lys Ala Asn Ile Leu Ala Leu Ile Ala Leu Phe Ala Leu Ile
20 25 30

Ala Val Pro Phe Thr Ile Lys Ala Val Arg Asn Lys Asn Thr Val Lys
35 40 45

Asp Thr Thr Ser Tyr Ser Thr Tyr Leu Ile Tyr Lys Ile Thr Pro Pro
50 55 60

Lys Glu Ser Asp Lys Thr Ile Leu Asn His Gln Ile Gly Gly Tyr Ser
65 70 75 80

Asp Phe Tyr Gly Lys Leu Ile Asp Gly Asn Leu Asn Gly Ala Tyr Leu
85 90 95

Phe Asn Asp Val Glu Pro Ser Glu Leu Lys Lys Ile Ala Ser Glu Leu
100 105 110

Asp Thr Thr Glu Thr Thr Leu Lys Asn Ser Thr Asn Asp Tyr Trp Trp
115 120 125

Lys Lys Leu Thr Val Tyr Tyr Met Ile Asp Asp Ala Gly Val Gly Val
130 135 140

Lys Ile Leu Thr Ser Ser Lys Asp Ala Asn Asn Leu Leu Glu Lys Lys
145 150 155 160

Ile Asp Gly Leu Ile Glu Lys Phe Lys His Ala Tyr Ala Asn Val Lys
165 170 175

Ile Glu Lys Leu Glu Thr Ile Asn Ser Lys Glu Leu Asn Ala Asn Gly
180 185 190

Glu Thr Ala Leu Gly Leu Asn Val Lys Asn Leu Ile Leu Arg Leu Val
195 200 205

Val Ile Gly Val Val Cys Val Ile Leu Val Val Met Gly Asn Val Leu
210 215 220

Val Tyr Leu Phe Asn Pro Thr Ile Asn Arg Val Gly Asp Phe Ser Gln
225 230 235 240

Tyr Gln Ile Asp Phe Val Thr Glu Ile Thr Thr Ile Ala Asn Leu Ala
245 250 255

Asp Val Leu Ser Tyr Lys Asn Thr Gly Gln Glu Leu Thr Ile Val Ser
260 265 270

Ser Asn Lys Ala Ile Leu Asp Lys Leu Lys Gln Ser Gln Glu Ala Leu
275 280 285

Lys Gly Met His Phe Val Asp Leu Gln Asp Val Ser Ser Leu Leu Glu
290 295 300

Arg Asp Thr Val Leu Leu Val Glu Glu Tyr Gly Val Thr Arg Tyr Lys
305 310 315 320

Lys Phe Glu Gln Ser Leu Gln Ile Leu Arg Asn Leu Asn Arg Ser Ile
325 330 335

Leu Gly Val Ala Thr Phe Lys Leu
340

<210> 684
<211> 424
<212> PRT
<213> Streptococcus pneumoniae

<400> 684

Met Ser Lys Glu Asn Pro Leu Ser His His Glu Gln Leu Arg Tyr Asp
1 5 10 15

Tyr Leu Leu Lys Asn Ile His Tyr Leu Asn Glu Arg Glu Lys Asn Glu
20 25 30

Phe Ala Tyr Leu Gln Glu Lys Leu Thr Leu Ala Arg Gly Asn Ser Ser
35 40 45

Ser Ser Leu Glu Gln Glu Arg Glu Glu Gln Val Asp Leu Pro Ser Tyr
50 55 60

Ala Asn Arg Ser Arg Ser Gln Ser Lys Ser Gln Ala Leu Ser Phe Pro
65 70 75 80

Pro Lys Lys Lys Arg Arg Lys Leu Arg Leu Lys Arg Ile Phe Met Val
85 90 95

Ile Phe Ser Leu Leu Val Cys Val Ala Leu Ala Met Val Phe Met Phe
100 105 110

Leu Arg Gly Tyr Gln Asp Ala Ser Ala Lys Lys Thr Ala Asp Ala Arg
115 120 125

Ala Ala Gln Val Glu Val Phe Asn Gly Gln Asp Thr Arg Asp Gly Val
130 135 140

Asn Ile Leu Ile Met Gly Thr Asp Gly Arg Ile Gly Gln Asn Ser Val
145 150 155 160

Glu Thr Arg Thr Asp Ser Ile Met Val Leu Asn Val Gly Gly Ser Asp
165 170 175

Lys Lys Met Lys Leu Val Ser Phe Met Arg Asp Asn Leu Val Tyr Ile
180 185 190

Asp Gly Tyr Ser Gln Val Ile Asn Gly Arg Lys Gln Thr Asp Asn Lys
195 200 205

Leu Asn Val Ala Tyr Glu Leu Gly Glu Gln Glu Gly Gln Lys Gly Ala
210 215 220

Glu Met Val Arg Gln Val Leu Lys Asp Asn Phe Asp Leu Asp Ile Lys
225   230   235   240

Tyr Tyr Ala Leu Val Asp Phe Gln Ala Phe Ala Thr Ala Ile Asp Thr
                245   250   255

Leu Phe Pro Asp Gly Val Thr Ile Asp Ala Gln Phe Ser Thr Leu Asn
            260   265   270

Gly Arg Pro Leu Thr Glu Ala Thr Val Gly Asp Asp Leu Tyr Ala Thr
        275   280   285

Glu Thr Glu Ser Pro Thr Gln Thr Ile Lys Val Gly Lys Gln Gln Met
    290   295   300

Asn Gly Ser Thr Leu Leu Asn Tyr Ala Arg Phe Arg Asp Asp Asp Glu
305   310   315   320

Ala Asp Tyr Gly Arg Thr Lys Arg Gln Gln Gln Val Leu Thr Ala Ile
                325   330   335

Leu Glu Gln Ile Lys Asp Pro Thr Lys Leu Phe Thr Gly Ser Glu Ala
            340   345   350

Leu Gly Lys Val Phe Ala Met Thr Ser Thr Asn Val Pro Tyr Thr Phe
        355   360   365

Leu Leu Thr Asn Gly Leu Ser Val Leu Asp Gly Ala Lys Asn Gly Ile
    370   375   380

Glu Lys Leu Thr Ile Pro Glu Leu Gly Asp Trp Val Asp Ala Tyr Asp
385   390   395   400

Val Tyr Gly Gly Leu Gly Leu Leu Val Asp Gln Asn Lys Tyr Gln Thr
                405   410   415

Lys Leu Ala Gln Met Gly Leu Arg
            420

<210> 685

<211> 267
<212> PRT
<213> Streptococcus pneumoniae

<400> 685

Met Ser Thr Tyr Asn Trp Asp Glu Lys His Ile Leu Thr Phe Pro Glu
1 5 10 15

Glu Lys Val Ala Leu Ser Thr Lys Asp Val His Val Tyr Tyr Gly Lys
20 25 30

Asn Glu Ser Ile Lys Gly Ile Asp Met Gln Phe Glu Arg Asn Lys Ile
35 40 45

Thr Ala Leu Ile Gly Pro Ser Gly Ser Gly Lys Ser Thr Tyr Leu Arg
50 55 60

Ser Leu Asn Arg Met Asn Asp Thr Ile Asp Ile Ala Lys Val Thr Gly
65 70 75 80

Gln Ile Leu Tyr Arg Gly Ile Asp Val Asn Arg Pro Glu Ile Asn Val
85 90 95

Tyr Glu Met Arg Lys His Ile Gly Met Val Phe Gln Arg Pro Asn Pro
100 105 110

Phe Ala Lys Ser Ile Tyr Arg Asn Ile Thr Phe Ala His Glu Arg Ala
115 120 125

Gly Val Lys Asp Lys Gln Val Leu Asp Glu Ile Val Glu Thr Ser Leu
130 135 140

Arg Gln Ala Ala Leu Trp Asp Gln Val Lys Asp Asp Leu His Lys Ser
145 150 155 160

Ala Leu Thr Leu Ser Gly Gly Gln Gln Gln Arg Leu Cys Ile Ala Arg
165 170 175

Ala Ile Ser Val Lys Pro Asp Ile Leu Leu Met Asp Glu Pro Ala Ser
180 185 190

Ala Leu Asp Pro Ile Ala Thr Met Gln Leu Glu Glu Thr Met Phe Glu

195 200 205

Leu Lys Lys Asn Phe Thr Ile Ile Ile Val Thr His Asn Met Gln Gln
210 215 220

Ala Ala Arg Ala Ser Asp Tyr Thr Gly Phe Phe Tyr Leu Gly Asp Leu
225 230 235 240

Ile Glu Tyr Asp Lys Thr Ala Thr Ile Phe Gln Asn Ala Lys Leu Gln
245 250 255

Ser Thr Asn Asp Tyr Val Ser Gly His Phe Gly
260 265

<210> 686
<211> 459
<212> PRT
<213> Streptococcus pneumoniae

<400> 686

Met Ser Lys Ile Val Val Val Gly Ala Asn His Ala Gly Thr Ala Cys
1 5 10 15

Ile Asn Thr Met Leu Asp Asn Phe Gly Asn Glu Asn Glu Ile Val Val
20 25 30

Phe Asp Gln Asn Ser Asn Ile Ser Phe Leu Gly Cys Gly Met Ala Leu
35 40 45

Trp Ile Gly Glu Gln Ile Asp Gly Ala Glu Gly Leu Phe Tyr Ser Asp
50 55 60

Lys Glu Lys Leu Glu Ala Lys Gly Ala Lys Val Tyr Met Asn Ser Pro
65 70 75 80

Val Leu Ser Ile Asp Tyr Asp Asn Lys Val Val Thr Ala Glu Val Glu
85 90 95

Gly Lys Glu His Lys Glu Ser Tyr Glu Lys Leu Ile Phe Ala Thr Gly
100 105 110

Ser Thr Pro Ile Leu Pro Pro Ile Glu Gly Val Glu Ile Val Lys Gly

```
        115                 120                 125

Asn Arg Glu Phe Lys Ala Thr Leu Glu Asn Val Gln Phe Val Lys Leu
    130                 135                 140

Tyr Gln Asn Ala Glu Glu Val Ile Asn Lys Leu Ser Asp Lys Ser Gln
145                 150                 155                 160

His Leu Asp Arg Ile Ala Val Val Gly Gly Gly Tyr Ile Gly Val Glu
                165                 170                 175

Leu Ala Glu Ala Phe Glu Arg Leu Gly Lys Glu Val Val Leu Val Asp
            180                 185                 190

Ile Val Asp Thr Val Leu Asn Gly Tyr Tyr Asp Lys Asp Phe Thr Gln
        195                 200                 205

Met Met Ala Lys Asn Leu Glu Asp His Asn Ile Arg Leu Ala Leu Gly
    210                 215                 220

Gln Thr Val Lys Ala Ile Glu Gly Asp Gly Lys Val Glu Arg Leu Ile
225                 230                 235                 240

Thr Asp Lys Glu Ser Phe Asp Val Asp Met Val Ile Leu Ala Val Gly
                245                 250                 255

Phe Arg Pro Asn Thr Ala Leu Ala Gly Gly Lys Ile Glu Leu Phe Arg
            260                 265                 270

Asn Gly Ala Phe Leu Val Asp Lys Lys Gln Glu Thr Ser Ile Pro Asp
        275                 280                 285

Val Tyr Ala Val Gly Asp Cys Ala Thr Val Tyr Asp Asn Ala Arg Lys
    290                 295                 300

Asp Thr Ser Tyr Ile Ala Leu Ala Ser Asn Ala Val Arg Thr Gly Ile
305                 310                 315                 320

Val Gly Ala Tyr Asn Ala Cys Gly His Glu Leu Glu Gly Ile Gly Val
                325                 330                 335
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Gln Gly Ser Asn Gly Ile Ser Ile Tyr Gly Leu His Met Val Ser Thr
340 345 350

Gly Leu Thr Leu Glu Lys Ala Lys Ala Ala Gly Tyr Asn Ala Thr Glu
355 360 365

Thr Gly Phe Asn Asp Leu Gln Lys Pro Glu Phe Met Lys His Asp Asn
370 375 380

His Glu Val Ala Ile Lys Ile Val Phe Asp Lys Asp Ser Arg Glu Ile
385 390 395 400

Leu Gly Ala Gln Met Val Ser His Asp Ile Ala Ile Ser Met Gly Ile
405 410 415

His Met Phe Ser Leu Ala Ile Gln Glu His Val Thr Ile Asp Lys Leu
420 425 430

Ala Leu Thr Asp Leu Phe Phe Leu Pro His Phe Asn Lys Pro Tyr Asn
435 440 445

Tyr Ile Thr Met Ala Ala Leu Thr Ala Glu Lys
450 455

<210> 687
<211> 404
<212> PRT
<213> Streptococcus pneumoniae

<400> 687

Met Glu Ala Phe Thr Gln Met Ala Lys Glu Lys Tyr Asp Arg Ser Lys
1 5 10 15

Pro His Val Asn Ile Gly Thr Ile Gly His Val Asp His Gly Lys Thr
20 25 30

Thr Leu Thr Ala Ala Ile Thr Thr Val Leu Ala Arg Arg Leu Pro Ser
35 40 45

Ser Val Asn Gln Pro Lys Asp Tyr Ala Ser Ile Asp Ala Ala Pro Glu
50 55 60

```
Glu Arg Glu Arg Gly Ile Thr Ile Asn Thr Ala His Val Glu Tyr Glu
65                  70                  75                  80

Thr Glu Lys Arg His Tyr Ala His Ile Asp Ala Pro Gly His Ala Asp
                85                  90                  95

Tyr Val Lys Asn Met Ile Thr Gly Ala Ala Gln Met Asp Gly Ala Ile
            100                 105                 110

Leu Val Val Ala Ser Thr Asp Gly Pro Met Pro Gln Thr Arg Glu His
        115                 120                 125

Ile Leu Leu Ser Arg Gln Val Gly Val Lys His Leu Ile Val Phe Met
    130                 135                 140

Asn Lys Val Asp Leu Val Asp Asp Glu Glu Leu Leu Glu Leu Val Glu
145                 150                 155                 160

Met Glu Ile Arg Asp Leu Leu Ser Glu Tyr Asp Phe Pro Gly Asp Asp
                165                 170                 175

Leu Pro Val Ile Gln Gly Ser Ala Leu Lys Ala Leu Glu Gly Asp Ser
            180                 185                 190

Lys Tyr Glu Asp Ile Val Met Glu Leu Met Asn Thr Val Asp Glu Tyr
        195                 200                 205

Ile Pro Glu Pro Glu Arg Asp Thr Asp Lys Pro Leu Leu Leu Pro Val
    210                 215                 220

Glu Asp Val Phe Ser Ile Thr Gly Arg Gly Thr Val Ala Ser Gly Arg
225                 230                 235                 240

Ile Asp Arg Gly Ile Val Lys Val Asn Asp Glu Ile Glu Ile Val Gly
                245                 250                 255

Ile Lys Glu Glu Thr Gln Lys Ala Val Val Thr Gly Val Glu Met Phe
            260                 265                 270

Arg Lys Gln Leu Asp Glu Gly Leu Ala Gly Asp Asn Val Gly Val Leu
        275                 280                 285
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Leu Arg Gly Val Gln Arg Asp Glu Ile Glu Arg Gly Gln Val Ile Ala
290 295 300

Lys Pro Gly Ser Ile Asn Pro His Thr Lys Phe Lys Gly Glu Val Tyr
305 310 315 320

Ile Leu Thr Lys Glu Glu Gly Gly Arg His Thr Pro Phe Phe Asn Asn
325 330 335

Tyr Arg Pro Gln Phe Tyr Phe Arg Thr Thr Asp Val Thr Gly Ser Ile
340 345 350

Glu Leu Pro Ala Gly Thr Glu Met Val Met Pro Gly Asp Asn Val Thr
355 360 365

Ile Asp Val Glu Leu Ile His Pro Ile Ala Val Glu Gln Gly Thr Thr
370 375 380

Phe Ser Ile Arg Glu Gly Gly Arg Thr Val Gly Ser Gly Met Val Thr
385 390 395 400

Glu Ile Glu Ala

<210> 688
<211> 289
<212> PRT
<213> Streptococcus pneumoniae

<400> 688

Met Asp Phe Thr Trp Ala Leu Lys Tyr Ala Thr Glu Phe Leu Gly Thr
1 5 10 15

Ala Ile Leu Ile Ile Leu Gly Asn Gly Ala Val Ala Asn Val Glu Leu
20 25 30

Lys Gly Thr Lys Gly His Gln Ser Gly Trp Ile Val Ile Ala Val Gly
35 40 45

Tyr Gly Met Gly Val Met Ile Pro Ala Leu Met Phe Gly Asn Val Ser
50 55 60

Gly Asn His Ile Asn Pro Ala Phe Thr Leu Gly Leu Ala Val Ser Gly
65 70 75 80

Leu Phe Pro Trp Ala Gln Val Val Pro Tyr Ile Ile Ala Gln Val Leu
85 90 95

Gly Ala Ile Phe Gly Gln Ala Leu Val Val Ala Thr Tyr Arg Pro Phe
100 105 110

Tyr Leu Lys Thr Glu Asn Pro Asn Asn Ile Leu Gly Thr Phe Ser Thr
115 120 125

Ile Ser Ser Ile Asp His Gly Thr Lys Glu Ser Arg Tyr Ala Ala Thr
130 135 140

Val Asn Gly Leu Ile Asn Glu Phe Val Gly Ser Phe Val Leu Phe Phe
145 150 155 160

Ala Ala Leu Gly Leu Thr Lys Asn Phe Phe Gly Ala Glu Val Leu Gln
165 170 175

Phe Met Lys Gln Lys Ala Thr Glu Ala Gly Gln Thr Val Asp Phe Ser
180 185 190

Asp Leu Ala Ile Lys Ala Gln Val Ala Pro His Thr Ala Ser Gly Leu
195 200 205

Ser Val Ala His Leu Ala Leu Gly Phe Leu Val Met Ala Leu Val Thr
210 215 220

Ser Leu Gly Gly Pro Thr Gly Pro Ala Leu Asn Pro Ala Arg Asp Leu
225 230 235 240

Gly Pro Arg Leu Leu His Ala Phe Leu Pro Lys Ser Val Leu Gly Glu
245 250 255

His Lys Gly Asp Ser Lys Trp Trp Tyr Ser Trp Val Pro Val Val Ala
260 265 270

Pro Ile Ala Ala Ala Ile Ala Ala Val Ala Val Phe Lys Phe Leu Tyr
275 280 285

Leu

<210> 689
<211> 468
<212> PRT
<213> Streptococcus pneumoniae

<400> 689

Met Ser Ser Gly Lys Ile Ala Gln Val Ile Gly Pro Val Val Asp Val
1 5 10 15

Leu Phe Ala Ala Gly Glu Lys Leu Pro Glu Ile Asn Asn Ala Leu Val
20 25 30

Val Tyr Lys Asn Asp Glu Arg Lys Thr Lys Ile Val Leu Glu Val Ala
35 40 45

Leu Glu Leu Gly Asp Gly Met Val Arg Thr Ile Ala Met Glu Ser Thr
50 55 60

Asp Gly Leu Thr Arg Gly Met Glu Val Leu Asp Thr Gly Arg Pro Ile
65 70 75 80

Ser Val Pro Val Gly Lys Glu Thr Leu Gly Arg Val Phe Asn Val Leu
85 90 95

Gly Asp Thr Ile Asp Leu Glu Ala Pro Phe Thr Glu Asp Ala Glu Arg
100 105 110

Gln Pro Ile His Lys Lys Ala Pro Thr Phe Asp Glu Leu Ser Thr Ser
115 120 125

Ser Glu Ile Leu Glu Thr Gly Ile Lys Val Ile Asp Leu Leu Ala Pro
130 135 140

Tyr Leu Lys Gly Gly Lys Val Gly Leu Phe Gly Gly Ala Gly Val Gly
145 150 155 160

Lys Thr Val Leu Ile Gln Glu Leu Ile His Asn Ile Ala Gln Glu His
165 170 175

Gly Gly Ile Ser Val Phe Ala Gly Val Gly Glu Arg Thr Arg Glu Gly
180 185 190

Asn Asp Leu Tyr Trp Glu Met Lys Glu Ser Gly Val Ile Glu Lys Thr
195 200 205

Ala Met Val Phe Gly Gln Met Asn Glu Pro Pro Gly Ala Arg Met Arg
210 215 220

Val Ala Leu Thr Gly Leu Thr Ile Ala Glu Tyr Phe Arg Asp Val Glu
225 230 235 240

Gly Gln Asp Val Leu Leu Phe Ile Asp Asn Ile Phe Arg Phe Thr Gln
245 250 255

Ala Gly Ser Glu Val Ser Ala Leu Leu Gly Arg Met Pro Ser Ala Val
260 265 270

Gly Tyr Gln Pro Thr Leu Ala Thr Glu Met Gly Gln Leu Gln Glu Arg
275 280 285

Ile Thr Ser Thr Lys Lys Gly Ser Val Thr Ser Ile Gln Ala Ile Tyr
290 295 300

Val Pro Ala Asp Asp Tyr Thr Asp Pro Ala Pro Ala Thr Ala Phe Ala
305 310 315 320

His Leu Asp Ser Thr Thr Asn Leu Glu Arg Lys Leu Val Gln Leu Gly
325 330 335

Ile Tyr Pro Ala Val Asp Pro Leu Ala Ser Ser Ser Arg Ala Leu Ala
340 345 350

Pro Glu Ile Val Gly Glu Glu His Tyr Ala Val Ala Ala Glu Val Lys
355 360 365

Arg Val Leu Gln Arg Tyr His Glu Leu Gln Asp Ile Ile Ala Ile Leu
370 375 380

Gly Met Asp Glu Leu Ser Asp Glu Glu Lys Thr Leu Val Ala Arg Ala

385 390 395 400

Arg Arg Ile Gln Phe Phe Leu Ser Gln Asn Phe Asn Val Ala Glu Gln
405 410 415

Phe Thr Gly Gln Pro Gly Ser Tyr Val Pro Val Ala Glu Thr Val Arg
420 425 430

Gly Phe Lys Glu Ile Leu Asp Gly Lys Tyr Asp His Leu Pro Glu Asp
435 440 445

Ala Phe Arg Gly Val Gly Ser Ile Glu Asp Val Ile Ala Lys Ala Glu
450 455 460

Lys Met Gly Phe
465

<210> 690
<211> 292
<212> PRT
<213> Streptococcus pneumoniae

<400> 690

Met Ala Val Ser Leu Asn Asp Ile Lys Thr Lys Ile Ala Ser Thr Lys
1 5 10 15

Asn Thr Ser Gln Ile Thr Asn Ala Met Gln Met Val Ser Ala Ala Lys
20 25 30

Leu Gly Arg Ser Glu Glu Ala Ala Arg Asn Phe Gln Val Tyr Ala Gln
35 40 45

Lys Val Arg Lys Leu Leu Thr Asp Ile Leu His Gly Asn Gly Ala Gly
50 55 60

Ala Ser Thr Asn Pro Met Leu Ile Ser Arg Ser Val Lys Lys Thr Gly
65 70 75 80

Tyr Ile Val Ile Thr Ser Asp Arg Gly Leu Val Gly Gly Tyr Asn Ser
85 90 95

Ser Ile Leu Lys Ala Val Met Glu Leu Lys Glu Glu Tyr His Pro Asp

100 105 110

Gly Lys Gly Phe Glu Met Ile Cys Ile Gly Gly Met Gly Ala Asp Phe
115 120 125

Phe Lys Ala Arg Gly Ile Gln Pro Leu Tyr Glu Leu Arg Gly Leu Ser
130 135 140

Asp Gln Pro Ser Phe Asp Gln Val Arg Lys Ile Ile Ser Lys Thr Val
145 150 155 160

Glu Met Tyr Gln Asn Glu Leu Phe Asp Glu Leu Tyr Val Cys Tyr Asn
165 170 175

His His Val Asn Thr Leu Thr Ser Gln Met Arg Val Glu Gln Met Leu
180 185 190

Pro Ile Val Asp Leu Asp Pro Asn Glu Ala Asp Glu Glu Tyr Ser Leu
195 200 205

Thr Phe Glu Leu Glu Thr Ser Arg Glu Glu Ile Leu Glu Gln Leu Leu
210 215 220

Pro Gln Phe Ala Glu Ser Met Ile Tyr Gly Ala Ile Ile Asp Ala Lys
225 230 235 240

Thr Ala Glu Asn Ala Ala Gly Met Thr Ala Met Gln Thr Ala Thr Asp
245 250 255

Asn Ala Lys Lys Val Ile Asn Asp Leu Thr Ile Gln Tyr Asn Arg Ala
260 265 270

Arg Gln Ala Ala Ile Thr Gln Glu Ile Thr Glu Ile Val Ala Gly Ala
275 280 285

Ser Ala Leu Glu
290

<210> 691
<211> 501
<212> PRT
<213> Streptococcus pneumoniae

<400> 691

Met Ala Ile Asn Ala Gln Glu Ile Ser Ala Leu Ile Lys Gln Gln Ile
1 5 10 15

Glu Asn Phe Lys Pro Asn Phe Asp Val Thr Glu Thr Gly Val Val Thr
20 25 30

Tyr Ile Gly Asp Gly Ile Ala Arg Ala His Gly Leu Glu Asn Val Met
35 40 45

Ser Gly Glu Leu Leu Asn Phe Glu Asn Gly Ser Tyr Gly Met Ala Gln
50 55 60

Asn Leu Glu Ser Thr Asp Val Gly Ile Ile Ile Leu Gly Asp Phe Thr
65 70 75 80

Asp Ile Arg Glu Gly Asp Thr Ile Arg Arg Thr Gly Lys Ile Met Glu
85 90 95

Val Pro Val Gly Glu Ser Leu Ile Gly Arg Val Val Asp Pro Leu Gly
100 105 110

Arg Pro Val Asp Gly Leu Gly Glu Ile His Thr Asp Lys Thr Arg Pro
115 120 125

Val Glu Ala Pro Ala Pro Gly Val Met Gln Arg Lys Ser Val Ser Glu
130 135 140

Pro Leu Gln Thr Gly Leu Lys Ala Ile Asp Ala Leu Val Pro Ile Gly
145 150 155 160

Arg Gly Gln Arg Glu Leu Ile Ile Gly Asp Arg Gln Thr Gly Lys Thr
165 170 175

Thr Ile Ala Ile Asp Thr Ile Leu Asn Gln Lys Asp Gln Asp Met Ile
180 185 190

Cys Ile Tyr Val Ala Ile Gly Gln Lys Glu Ser Thr Val Arg Thr Gln
195 200 205

Val Glu Thr Leu Arg Gln Tyr Gly Ala Leu Asp Tyr Thr Ile Val Val
    210   215   220

Thr Ala Ser Ala Ser Gln Pro Ser Pro Leu Leu Phe Leu Ala Pro Tyr
225   230   235   240

Ala Gly Val Ala Met Ala Glu Glu Phe Met Tyr Gln Gly Lys His Val
                245   250   255

Leu Ile Val Tyr Asp Asp Leu Ser Lys Gln Ala Val Ala Tyr Arg Glu
            260   265   270

Leu Ser Leu Leu Leu Arg Arg Pro Pro Gly Arg Glu Ala Phe Pro Gly
        275   280   285

Asp Val Phe Tyr Leu His Ser Arg Leu Leu Glu Arg Ser Ala Lys Val
    290   295   300

Ser Asp Glu Leu Gly Gly Gly Ser Ile Thr Ala Leu Pro Phe Ile Glu
305   310   315   320

Thr Gln Ala Gly Asp Ile Ser Ala Tyr Ile Ala Thr Asn Val Ile Ser
                325   330   335

Ile Thr Asp Gly Gln Ile Phe Leu Gly Asp Gly Leu Phe Asn Ala Gly
            340   345   350

Ile Arg Pro Ala Ile Asp Ala Gly Ser Ser Val Ser Arg Val Gly Gly
        355   360   365

Ser Ala Gln Ile Lys Ala Met Lys Lys Val Ala Gly Thr Leu Arg Ile
    370   375   380

Asp Leu Ala Ser Tyr Arg Glu Leu Glu Ala Phe Thr Lys Phe Gly Ser
385   390   395   400

Asp Leu Asp Ala Ala Thr Gln Ala Lys Leu Asn Arg Gly Arg Arg Thr
                405   410   415

Val Glu Val Leu Lys Gln Pro Val His Lys Pro Leu Pro Val Glu Lys
            420   425   430

```
Gln Val Thr Ile Leu Tyr Ala Leu Thr His Gly Phe Leu Asp Thr Val
        435                     440                     445

Pro Val Asp Asp Ile Val Arg Phe Glu Glu Glu Phe His Ala Phe Phe
    450                 455                     460

Asp Ala Gln His Pro Glu Ile Leu Glu Thr Ile Arg Asp Thr Lys Asp
465                 470                     475                 480

Leu Pro Glu Glu Ala Val Leu Asp Ala Ala Ile Thr Glu Phe Leu Asn
                485                     490                     495

Gln Ser Ser Phe Gln
            500
```

<210> 692
<211> 178
<212> PRT
<213> Streptococcus pneumoniae

<400> 692

```
Met Asp Lys Lys Thr Val Lys Val Ile Glu Lys Tyr Ser Met Pro Phe
1               5                   10                  15

Val Gln Leu Val Leu Glu Lys Gly Glu Glu Asp Arg Ile Phe Ser Asp
            20                  25                  30

Leu Thr Gln Ile Lys Gln Val Val Glu Lys Thr Gly Leu Pro Ser Phe
        35                  40                  45

Leu Lys Gln Val Ala Val Asp Glu Ser Asp Lys Glu Lys Thr Ile Ala
    50                  55                  60

Phe Phe Gln Asp Ser Val Ser Pro Leu Leu Gln Asn Phe Ile Gln Val
65                  70                  75                  80

Leu Ala Tyr Asn His Arg Ala Asn Leu Phe Tyr Asp Val Leu Val Asp
                85                  90                  95

Cys Leu Asn Arg Leu Glu Lys Glu Thr Asn Arg Phe Glu Val Thr Ile
            100                 105                 110
```

Thr Ser Ala His Pro Leu Thr Asp Glu Gln Lys Thr Arg Leu Leu Pro
115 120 125

Leu Ile Glu Lys Lys Met Ser Leu Lys Val Arg Ser Val Lys Glu Gln
130 135 140

Ile Asp Glu Ser Leu Ile Gly Gly Phe Val Ile Phe Ala Asn His Lys
145 150 155 160

Thr Ile Asp Val Ser Ile Lys Gln Gln Leu Lys Val Val Lys Glu Asn
165 170 175

Leu Lys

<210> 693
<211> 164
<212> PRT
<213> Streptococcus pneumoniae

<400> 693

Met His Val Thr Val Gly Glu Leu Ile Gly Asn Phe Ile Leu Ile Thr
1 5 10 15

Gly Ser Phe Ile Leu Leu Leu Val Leu Ile Lys Lys Phe Ala Trp Ser
20 25 30

Asn Ile Thr Gly Ile Phe Glu Glu Arg Ala Glu Lys Ile Ala Ser Asp
35 40 45

Ile Asp Arg Ala Glu Glu Ala Arg Gln Lys Ala Glu Val Leu Ala Gln
50 55 60

Lys Arg Glu Asp Glu Leu Ala Gly Ser Arg Lys Glu Ala Lys Thr Ile
65 70 75 80

Ile Glu Asn Ala Lys Glu Thr Ala Glu Gln Ser Lys Ala Asn Ile Leu
85 90 95

Ala Asp Ala Lys Leu Glu Ala Gly His Leu Lys Glu Lys Ala Asn Gln
100 105 110

```
Glu Ile Ala Gln Asn Lys Val Glu Ala Leu Gln Ser Val Lys Gly Glu
        115                 120                 125

Val Ala Asp Leu Thr Ile Ser Leu Ala Gly Lys Ile Ile Ser Gln Asn
    130                 135                 140

Leu Asp Ser His Ala His Lys Ala Leu Ile Asp Gln Tyr Ile Asp Gln
145                 150                 155                 160

Leu Gly Glu Ala


<210>  694
<211>  466
<212>  PRT
<213>  Streptococcus pneumoniae

<400>  694

Met Asp Ala Lys Leu Arg Tyr Lys Ala Lys Lys Ile Lys Ile Val Phe
1               5                   10                  15

Phe Asp Ile Asp Asp Thr Leu Arg Asn Ser Lys Thr Gly Phe Ile Pro
            20                  25                  30

Thr Thr Ile Pro Thr Val Phe Lys Gln Leu Arg Glu Lys Gly Ile Leu
        35                  40                  45

Thr Gly Ile Ala Ser Gly Arg Gly Ile Phe Gly Val Val Pro Glu Ile
    50                  55                  60

Arg Asp Leu Lys Pro Asp Phe Phe Val Thr Leu Asn Gly Ala Tyr Ile
65                  70                  75                  80

Glu Asp Lys Lys Gly Gln Val Ile Tyr Gln His Gln Ile Glu Lys Ser
                85                  90                  95

Asp Val Glu Glu Tyr Ile Ser Trp Ala Lys Gln Glu Gly Ile Glu Tyr
            100                 105                 110

Gly Leu Val Gly Ser His Asp Ala Lys Leu Ser Thr Arg Thr Asp Met
        115                 120                 125
```

Met Ser Glu Ala Ile Asn Pro Ile Tyr Pro Asp Leu Asp Val Asp Pro
130 135 140

Asp Phe His Glu Lys Glu Asp Ile Tyr Gln Met Trp Thr Phe Glu Asp
145 150 155 160

Lys Gly Asp Asp Leu His Leu Pro Asp Ser Leu Ser Asp Lys Leu Arg
165 170 175

Met Val Arg Trp His Gln His Ser Ser Asp Ile Val Pro Ile Ser Gly
180 185 190

Ser Lys Ala Thr Gly Val Glu Lys Val Val Glu His Leu Gly Leu Lys
195 200 205

Pro Glu Lys Val Met Val Phe Gly Asp Gly Leu Asn Asp Leu Glu Leu
210 215 220

Phe Asp Tyr Ala Gly Ile Ser Val Ala Met Gly Ile Ser His Asp Lys
225 230 235 240

Ile Lys Glu Lys Ala Asp Tyr Ile Thr Lys Thr Leu Glu Glu Asp Gly
245 250 255

Ile Phe Ala Ala Leu Glu Val Phe Gly Met Val Glu Lys Glu Leu His
260 265 270

Phe Pro Gln Val Asp Ile Glu Thr Val Glu Gly Pro Leu Ala Thr Ile
275 280 285

Lys Thr Asn His Gly Asp Leu Arg Ile Lys Leu Phe Pro Glu His Ala
290 295 300

Pro Lys Thr Val Ala Asn Phe Val Ser Leu Ser Lys Asp Gly Tyr Tyr
305 310 315 320

Asp Gly Val Ile Phe His Arg Ile Ile Lys Asp Phe Met Ile Gln Gly
325 330 335

Gly Asp Pro Thr Gly Thr Gly Met Gly Gly Glu Ser Ile Tyr Gly Glu
340 345 350

Ser Phe Glu Asp Glu Phe Ser Glu Glu Leu Tyr Asn Ile Arg Gly Ala
355 360 365

Leu Ser Met Ala Asn Ala Gly Pro Asn Thr Asn Gly Ser Gln Phe Phe
370 375 380

Ile Val Gln Asn Gln His Leu Pro Tyr Ser Lys Lys Glu Ile Thr Arg
385 390 395 400

Gly Gly Trp Pro Glu Pro Ile Ala Glu Ile Tyr Ala Asn Gln Gly Gly
405 410 415

Thr Pro His Leu Asp Arg Arg His Thr Val Phe Gly Gln Leu Ala Asp
420 425 430

Glu Ala Ser Tyr Ala Val Leu Asp Ala Ile Ala Ala Val Glu Thr Gly
435 440 445

Ala Met Asp Lys Pro Val Glu Asp Val Val Ile Glu Thr Ile Glu Ile
450 455 460

Glu Asp
465

<210> 695
<211> 79
<212> PRT
<213> Streptococcus pneumoniae

<400> 695

Met Ala Gln Gln Arg Arg Gly Gly Phe Lys Arg Arg Lys Lys Val Asp
1 5 10 15

Tyr Ile Ala Ala Asn Lys Ile Glu Tyr Val Asp Tyr Lys Asp Thr Glu
20 25 30

Leu Leu Ser Arg Phe Val Ser Glu Arg Gly Lys Ile Leu Pro Arg Arg
35 40 45

Val Thr Gly Thr Ser Ala Lys Asn Gln Arg Lys Val Thr Thr Ala Ile
50 55 60

Lys Arg Ala Arg Val Met Ala Leu Met Pro Phe Val Asn Glu Asp
65 70 75

<210> 696
<211> 96
<212> PRT
<213> Streptococcus pneumoniae

<400> 696

Met Ala Lys Tyr Glu Ile Leu Tyr Ile Ile Arg Pro Asn Ile Glu Glu
1 5 10 15

Glu Ala Lys Asn Ala Leu Val Ala Arg Phe Asp Ser Ile Leu Thr Asp
20 25 30

Asn Gly Ala Thr Val Val Glu Ser Lys Thr Trp Glu Lys Arg Arg Leu
35 40 45

Ala Tyr Glu Ile Gln Asp Phe Arg Glu Gly Leu Tyr His Ile Val Asn
50 55 60

Val Glu Ala Asn Asp Asp Ala Ala Leu Lys Glu Phe Asp Arg Leu Ser
65 70 75 80

Lys Ile Asn Ala Asp Ile Leu Arg His Met Ile Val Lys Ile Asp Ala
85 90 95

<210> 697
<211> 531
<212> PRT
<213> Streptococcus pneumoniae

<400> 697

Met Lys Arg Ile Val Phe Glu Leu Ile Phe Ile Ala Thr Thr Trp Tyr
1 5 10 15

Ile Phe Leu Pro Pro Leu Asn Leu Thr Ser Trp Glu Phe Leu Phe Phe
20 25 30

Leu Cys Gly His Leu Leu Val Val Ala Ile Leu Phe Gly Phe Gly Lys
35 40 45

Gly Ile Asn Leu Val Lys Thr Val His Val Arg His Gly Lys Ala Glu
50 55 60

Ala Ala Leu Asn Leu Glu Gly Phe Lys Ile Asn Arg Leu Gly Lys Ile
65 70 75 80

Leu Leu Ala Ser Ile Gly Gly Ile Leu Leu Leu Ala Ala Leu Val Ser
85 90 95

Leu Val Thr Ser Ser Met Phe Gln Ala Lys Asn Tyr Ala Asn Val Val
100 105 110

Thr Val Thr Glu Lys Asp Phe Thr Glu Phe Pro Lys Ser Asp Thr Ser
115 120 125

Lys Val Pro Ile Leu Asp Arg Ser Thr Ala Glu Lys Ile Gly Asp Arg
130 135 140

Tyr Leu Gly Ser Leu Thr Asp Lys Val Ser Gln Tyr Val Ala Ala Asp
145 150 155 160

Thr Tyr Thr Gln Leu Thr Ile Asp Gly Lys Pro Tyr Arg Val Thr Pro
165 170 175

Leu Glu Tyr Ala Asp Pro Ile Lys Trp Phe Asn Asn Gln Ala Lys Gly
180 185 190

Ile Gly Glu Tyr Ile Lys Val Asp Met Val Thr Gly Asn Ala Asp Leu
195 200 205

Val Asp Leu Lys Thr Pro Ile Lys Tyr Ser Asp Ser Glu Tyr Phe Asn
210 215 220

Arg Asp Val Lys Arg His Leu Arg Leu Lys Tyr Pro Thr Lys Ile Phe
225 230 235 240

Lys Thr Pro Ser Phe Glu Val Asp Asp Glu Gly Asn Pro Phe Tyr Val
245 250 255

Ala Thr Val Tyr Gln Lys Gln Phe Gly Leu Ala Val Pro Arg Pro Ala
260 265 270

Ser Val Ile Ile Leu Asp Ala Thr Asn Gly Glu Thr Lys Glu Tyr Ser
        275   280   285

Leu Ser Asp Val Pro Glu Trp Val Asp Arg Ile Tyr Pro Ala Glu Glu
    290   295   300

Thr Ile Glu Gln Ile Asn Tyr Asn Gly Lys Tyr Lys Asp Gly Phe Leu
305   310   315   320

Asn Ala Met Ile Ser Lys Lys Asn Val Thr Gln Thr Thr Asn Gly Tyr
                325   330   335

Asn Tyr Leu Ser Ile Gly Asn Asp Ile Tyr Leu Tyr Thr Gly Val Thr
            340   345   350

Ser Ala Asn Ala Asp Glu Ser Asn Leu Gly Phe Ile Leu Glu Asn Met
        355   360   365

Arg Thr Gly Glu Ile Thr Lys Tyr Ser Leu Ala Ser Ala Thr Glu Glu
    370   375   380

Ser Ala Arg Glu Ser Ala Glu Gly Ala Val Gln Glu Lys Ser Tyr Lys
385   390   395   400

Ala Thr Phe Pro Ile Leu Ile Asn Leu Asn Asp Lys Pro Leu Tyr Ile
                405   410   415

Met Gly Leu Lys Asp Asn Ala Gly Leu Val Lys Glu Tyr Ala Leu Val
            420   425   430

Asp Ala Val Glu Tyr Gln Asn Val Ile Val Ala Thr Thr Val Glu Glu
        435   440   445

Met Leu Ser Lys Tyr Ala Asn Lys Asn Asp Leu Glu Ile Asp Asn Ala
    450   455   460

Thr Thr Glu Ser Ile Asn Gly Val Val Ala Asp Leu Lys Ser Ala Val
465   470   475   480

Ile Lys Gly Asp Thr Val Tyr Phe Phe Lys Val Asp Gly Lys Ile Tyr

485 490 495

Lys Val Lys Ala Ser Val Ser Asp Asp Leu Pro Tyr Leu Glu Asn Gly
500 505 510

Lys Thr Phe Glu Gly Gln Val Gly Lys Asp Asn Tyr Leu Lys Thr Phe
515 520 525

Lys Leu Arg
530

<210> 698
<211> 914
<212> PRT
<213> Streptococcus pneumoniae

<400> 698

Met Thr Glu Arg Glu Ser Val Leu His Thr Met Ser Arg Arg Arg His
1 5 10 15

Met Ser Lys Glu Gln Lys Arg Gln Ala Phe Tyr Thr Gln Ser Pro Glu
20 25 30

Glu Val Leu Gln Ala Val Asp Ala Thr Glu Gln Gly Leu Ser Ser Ser
35 40 45

Glu Ala Glu Lys Arg Leu Ala Glu Phe Gly His Asn Glu Leu Glu Glu
50 55 60

Gly Glu Lys Arg Ser Ile Leu Val Lys Phe Ile Glu Gln Phe Lys Asp
65 70 75 80

Leu Met Ile Ile Ile Leu Val Ala Ala Ala Ile Leu Ser Val Val Thr
85 90 95

Ser Gly Gly Glu Asp Ile Ala Asp Ala Ile Ile Ile Leu Ala Val Val
100 105 110

Ile Ile Asn Ala Ala Phe Gly Val Tyr Gln Glu Gly Lys Ala Glu Glu
115 120 125

Ala Ile Glu Ala Leu Lys Ser Met Ser Ser Pro Val Ala Arg Val Leu

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    130                 135                 140

Arg Asp Gly His Met Ala Glu Ile Asp Ser Lys Glu Leu Val Pro Gly
145                 150                 155                 160

Asp Ile Val Ala Leu Glu Ala Gly Asp Val Val Pro Ala Asp Leu Arg
                165                 170                 175

Leu Ile Glu Ala Asn Ser Leu Lys Ile Glu Glu Ala Ala Leu Thr Gly
            180                 185                 190

Glu Ser Val Pro Val Glu Lys Asp Leu Ser Val Glu Leu Ala Thr Asp
        195                 200                 205

Ala Gly Ile Gly Asp Arg Val Asn Met Ala Phe Gln Asn Ser Asn Val
    210                 215                 220

Thr Tyr Gly Arg Gly Met Gly Val Val Val Asn Thr Gly Met Tyr Thr
225                 230                 235                 240

Glu Val Gly His Ile Ala Gly Met Leu Gln Asp Ala Asp Glu Thr Asp
                245                 250                 255

Thr Pro Leu Lys Gln Asn Leu Asn Asn Leu Ser Lys Val Leu Thr Tyr
            260                 265                 270

Ala Ile Leu Val Ile Ala Leu Val Thr Phe Val Val Gly Val Phe Ile
        275                 280                 285

Gln Gly Lys Asn Pro Leu Gly Glu Leu Leu Thr Ser Val Ala Leu Ala
    290                 295                 300

Val Ala Ala Ile Pro Glu Gly Leu Pro Ala Ile Val Thr Ile Val Leu
305                 310                 315                 320

Ser Leu Gly Thr Gln Val Leu Ala Lys Arg His Ser Ile Val Arg Lys
                325                 330                 335

Leu Pro Ala Val Glu Thr Leu Gly Ser Thr Glu Ile Ile Ala Ser Asp
            340                 345                 350
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Lys Thr Gly Thr Leu Thr Met Asn Lys Met Thr Val Glu Lys Val Phe
355 360 365

Tyr Asp Ala Val Leu His Asp Ser Ala Asp Asp Ile Glu Leu Gly Leu
370 375 380

Glu Met Pro Leu Leu Arg Ser Val Val Leu Ala Asn Asp Thr Lys Ile
385 390 395 400

Asp Val Glu Gly Asn Leu Ile Gly Asp Pro Thr Glu Thr Ala Phe Ile
405 410 415

Gln Tyr Ala Leu Asp Lys Gly Tyr Asp Val Lys Gly Phe Leu Glu Lys
420 425 430

Tyr Pro Arg Val Ala Glu Leu Pro Phe Asp Ser Asp Arg Lys Leu Met
435 440 445

Ser Thr Val His Pro Leu Pro Asp Gly Arg Phe Leu Val Ala Val Lys
450 455 460

Gly Ala Pro Asp Gln Leu Leu Lys Arg Cys Leu Leu Arg Asp Lys Ala
465 470 475 480

Gly Asp Ile Ala Pro Ile Asp Glu Lys Val Thr Asn Leu Ile Arg Thr
485 490 495

Asn Asn Ser Glu Met Ala His Gln Ala Leu Arg Val Leu Ala Gly Ala
500 505 510

Tyr Lys Ile Ile Asp Ser Ile Pro Glu Asn Leu Thr Ser Glu Glu Leu
515 520 525

Glu Asn Asp Leu Ile Phe Thr Gly Leu Ile Gly Met Ile Asp Pro Glu
530 535 540

Arg Pro Glu Ala Ala Glu Ala Val Arg Val Ala Lys Glu Ala Gly Ile
545 550 555 560

Arg Pro Ile Met Ile Thr Gly Asp His Gln Asp Thr Ala Glu Ala Ile
565 570 575

Ala Lys Arg Leu Gly Ile Ile Asp Ala Asn Asp Thr Glu Gly His Val
580 585 590

Leu Thr Gly Ala Glu Leu Asn Glu Leu Ser Asp Glu Glu Phe Glu Lys
595 600 605

Val Val Gly Gln Tyr Ser Val Tyr Ala Arg Val Ser Pro Glu His Lys
610 615 620

Val Arg Ile Val Lys Ala Trp Gln Lys Gln Gly Lys Val Val Ala Met
625 630 635 640

Thr Gly Asp Gly Val Asn Asp Ala Pro Ala Leu Lys Thr Ala Asp Ile
645 650 655

Gly Ile Gly Met Gly Ile Thr Gly Thr Glu Val Ser Lys Gly Ala Ser
660 665 670

Asp Met Ile Leu Ala Asp Asp Asn Phe Ala Thr Ile Ile Val Ala Val
675 680 685

Glu Glu Gly Arg Lys Val Phe Ser Asn Ile Gln Lys Thr Ile Gln Tyr
690 695 700

Leu Leu Ser Ala Asn Thr Ala Glu Val Leu Thr Ile Phe Leu Ser Thr
705 710 715 720

Leu Phe Gly Trp Asp Val Leu Gln Pro Val His Leu Leu Trp Ile Asn
725 730 735

Leu Val Thr Asp Thr Phe Pro Ala Ile Ala Leu Gly Val Glu Pro Ala
740 745 750

Glu Pro Gly Val Met Asn His Lys Pro Arg Gly Arg Lys Ala Ser Phe
755 760 765

Phe Ser Gly Gly Val Leu Ser Ser Ile Ile Tyr Gln Gly Val Leu Gln
770 775 780

Ala Ala Leu Val Met Ser Val Tyr Gly Leu Ala Ile Ala Tyr Pro Val
785 790 795 800

His Val Gly Asp Asn His Ala Ile His Ala Asp Ala Leu Thr Met Ala
805 810 815

Phe Ala Thr Leu Gly Leu Ile Gln Leu Phe His Ala Tyr Asn Val Lys
820 825 830

Ser Val Tyr Gln Ser Ile Leu Thr Val Gly Pro Phe Lys Ser Lys Thr
835 840 845

Phe Asn Trp Ser Ile Leu Val Ser Phe Ile Leu Leu Met Ala Thr Ile
850 855 860

Val Val Glu Pro Leu Glu Gly Ile Phe His Val Thr Lys Leu Asp Leu
865 870 875 880

Ser Gln Trp Gly Ile Val Met Ala Gly Ser Phe Ser Met Ile Ile Ile
885 890 895

Val Glu Ile Val Lys Phe Ile Gln Arg Lys Leu Gly Phe Asp Lys Asn
900 905 910

Ala Ile

<210> 699
<211> 292
<212> PRT
<213> Streptococcus pneumoniae

<400> 699

Met Ile Gly Arg Ile Ser Gly Met Asn Phe Gln Gln Leu Ser Asn Leu
1 5 10 15

Gln Tyr Trp Thr Ser Leu Phe Ala Ser Pro Trp Thr Ile Ala Ile Asn
20 25 30

Leu Ile Asp Ile Leu Ile Val Ala Tyr Ile Leu Tyr His Phe Thr Lys
35 40 45

Ala Ile Ala Gly Thr Lys Ile Met Ile Leu Val Arg Gly Val Leu Val
50 55 60

Phe Ile Leu Ala Gln Ile Leu Ala Asn Met Ile Gly Leu Thr Thr Ile
65 70 75 80

Ser Trp Leu Ile Asn Gln Ile Ile Thr Tyr Gly Val Ile Ala Ala Val
85 90 95

Val Ile Phe Ser Pro Glu Ile Arg Thr Gly Leu Glu Arg Leu Gly Arg
100 105 110

Ala Thr Asp Phe Phe Ser Asn Ala Pro Ile Ser Ala Glu Glu Gln Met
115 120 125

Ile Arg Ala Phe Val Lys Ser Val Glu Tyr Met Ser Pro Arg Lys Ile
130 135 140

Gly Ala Leu Val Ala Ile Gln Arg Val Arg Thr Leu Gln Glu Tyr Ile
145 150 155 160

Ser Thr Gly Ile Pro Leu Asp Ala Lys Ile Ser Ala Glu Leu Leu Ile
165 170 175

Asn Ile Phe Ile Pro Asn Thr Pro Leu His Asp Gly Ala Val Ile Ile
180 185 190

Lys Glu Glu Arg Ile Ala Val Thr Ser Ala Tyr Leu Pro Leu Thr Lys
195 200 205

Asn Thr Gly Ile Ser Lys Glu Phe Gly Thr Arg His Arg Ala Ala Ile
210 215 220

Gly Leu Ser Glu Val Ser Asp Ala Leu Thr Phe Val Val Ser Glu Glu
225 230 235 240

Thr Gly Gly Ile Ser Ile Thr Tyr Asn Gly Arg Phe Lys His Asn Leu
245 250 255

Thr Leu Asp Glu Phe Glu Thr Glu Leu Arg Glu Ile Leu Leu Pro Lys
260 265 270

Glu Glu Val Gly Leu Ser Phe Lys Glu Arg Leu Leu Gly Gly Trp Lys

275 280 285

His Glu Lys Lys
290

<210> 700
<211> 410
<212> PRT
<213> Streptococcus pneumoniae

<400> 700

Met Ser Thr Asn Arg Lys Asn Asp Met Met Val Tyr Cys Ser Phe Cys
1 5 10 15

Gly Lys Asn Gln Glu Glu Val Gln Lys Ile Ile Ala Gly Asn Asn Ala
20 25 30

Phe Ile Cys Asn Glu Cys Val Glu Leu Ala Gln Glu Ile Ile Arg Glu
35 40 45

Glu Leu Val Glu Glu Val Leu Ala Asp Leu Ser Glu Val Pro Lys Pro
50 55 60

Ile Glu Leu Leu His Ile Leu Asn His Tyr Val Ile Gly Gln Asp Arg
65 70 75 80

Ala Lys Arg Ala Leu Ala Val Ala Val Tyr Asn His Tyr Lys Arg Ile
85 90 95

Asn Phe His Asp Thr Arg Glu Glu Ser Glu Asp Val Asp Leu Gln Lys
100 105 110

Ser Asn Ile Leu Met Ile Gly Pro Thr Gly Ser Gly Lys Thr Phe Leu
115 120 125

Ala Gln Thr Leu Ala Lys Ser Leu Asn Val Pro Phe Ala Ile Ala Asp
130 135 140

Ala Thr Ala Leu Thr Glu Ala Gly Tyr Val Gly Glu Asp Val Glu Asn
145 150 155 160

Ile Leu Leu Lys Leu Leu Gln Val Ala Asp Phe Asn Ile Glu Arg Ala

165 170 175

Glu Arg Gly Ile Ile Tyr Val Asp Glu Ile Asp Lys Ile Ala Lys Lys
180 185 190

Ser Glu Asn Val Ser Ile Thr Arg Asp Val Ser Gly Glu Gly Val Gln
195 200 205

Gln Ala Leu Leu Lys Ile Ile Glu Gly Thr Val Ala Ser Val Pro Pro
210 215 220

Gln Gly Gly Arg Lys His Pro Gln Gln Glu Met Ile Gln Val Asp Thr
225 230 235 240

Lys Asn Ile Leu Phe Ile Val Gly Gly Ala Phe Asp Gly Ile Glu Glu
245 250 255

Ile Val Lys Gln Arg Leu Gly Glu Lys Val Ile Gly Phe Gly Gln Asn
260 265 270

Asn Lys Ala Ile Asp Glu Asn Ser Ser Tyr Met Gln Glu Ile Ile Ala
275 280 285

Glu Asp Ile Gln Lys Phe Gly Ile Ile Pro Glu Leu Ile Gly Arg Leu
290 295 300

Pro Val Phe Ala Ala Leu Glu Gln Leu Thr Val Asp Asp Leu Val Arg
305 310 315 320

Ile Leu Lys Glu Pro Arg Asn Ala Leu Val Lys Gln Tyr Gln Thr Leu
325 330 335

Leu Ser Tyr Asp Asp Val Glu Leu Glu Phe Asp Asp Glu Ala Leu Gln
340 345 350

Glu Ile Ala Asn Lys Ala Ile Glu Arg Lys Thr Gly Ala Arg Gly Leu
355 360 365

Arg Ser Ile Ile Glu Glu Thr Met Leu Asp Val Met Phe Glu Val Pro
370 375 380

Ser Gln Glu Asn Val Lys Leu Val Arg Ile Thr Lys Glu Thr Val Asp
385 390 395 400

Gly Thr Asp Lys Pro Ile Leu Glu Thr Ala
405 410

<210> 701
<211> 376
<212> PRT
<213> Streptococcus pneumoniae

<400> 701

Met Val Glu Leu Asn Leu Lys Asn Ile Tyr Lys Lys Tyr Pro Asn Ser
1 5 10 15

Glu His Tyr Ser Val Glu Asp Phe Asn Leu Asn Ile Lys Asp Lys Glu
20 25 30

Phe Ile Val Phe Val Gly Pro Ser Gly Cys Gly Lys Ser Thr Thr Leu
35 40 45

Arg Met Ile Ala Gly Leu Glu Asp Ile Thr Glu Gly Thr Ala Ser Ile
50 55 60

Asp Gly Val Val Val Asn Asp Val Ala Pro Lys Asp Arg Asp Ile Ala
65 70 75 80

Met Val Phe Gln Asn Tyr Ala Leu Tyr Pro His Met Thr Val Tyr Asp
85 90 95

Asn Met Ala Phe Gly Leu Lys Leu Arg Lys Tyr Ser Lys Glu Asp Ile
100 105 110

Asn Lys Arg Val Gln Glu Ala Ala Glu Ile Leu Gly Leu Lys Glu Phe
115 120 125

Leu Glu Arg Lys Pro Ala Asp Leu Ser Gly Gly Gln Arg Gln Arg Val
130 135 140

Ala Met Gly Arg Ala Ile Val Arg Asp Ala Lys Val Phe Leu Met Asp
145 150 155 160

Glu Pro Leu Ser Asn Leu Asp Ala Lys Leu Arg Val Ser Met Arg Ala
165 170 175

Glu Ile Ala Lys Ile His Arg Arg Ile Gly Ala Thr Thr Ile Tyr Val
180 185 190

Thr His Asp Gln Thr Glu Ala Met Thr Leu Ala Asp Arg Ile Val Ile
195 200 205

Met Ser Ala Thr Lys Asn Pro Ala Gly Thr Gly Thr Ile Gly Arg Val
210 215 220

Glu Gln Ile Gly Thr Pro Gln Glu Val Tyr Lys Asn Pro Val Asn Lys
225 230 235 240

Phe Val Ala Gly Phe Ile Gly Ser Pro Ala Met Asn Phe Ile Thr Val
245 250 255

Lys Leu Val Gly Ser Glu Ile Val Ser Asp Gly Phe Arg Leu Lys Val
260 265 270

Pro Glu Gly Ala Leu Lys Val Leu Arg Glu Lys Gly Tyr Glu Gly Lys
275 280 285

Glu Leu Ile Phe Gly Ile Arg Pro Glu Asp Val Asn Ala Glu Pro Ala
290 295 300

Phe Leu Glu Thr Phe Pro Asp Cys Val Val Lys Ala Thr Ile Ser Val
305 310 315 320

Ser Glu Leu Leu Gly Ser Glu Ser His Leu Tyr Cys Gln Val Gly Lys
325 330 335

Asp Glu Phe Val Ala Lys Val Asp Ala Arg Asp Tyr Leu Gln Thr Gly
340 345 350

Ala Thr Val Glu Leu Gly Phe Asp Leu Asn Lys Ala His Phe Phe Asp
355 360 365

Val Glu Thr Glu Lys Thr Ile Tyr
370 375

<210> 702
<211> 524
<212> PRT
<213> Streptococcus pneumoniae

<400> 702

Met Lys Phe Asn Glu Leu Asn Leu Ser Ala Asp Leu Leu Ala Glu Ile
1   5   10   15

Glu Lys Ala Gly Phe Val Glu Ala Ser Pro Ile Gln Glu Gln Thr Ile
            20   25   30

Pro Leu Ala Leu Glu Gly Lys Asp Val Ile Gly Gln Ala Gln Thr Gly
        35   40   45

Thr Gly Lys Thr Ala Ala Phe Gly Leu Pro Thr Leu Glu Lys Ile Arg
    50   55   60

Thr Glu Glu Ala Thr Ile Gln Ala Leu Val Ile Ala Pro Thr Arg Glu
65   70   75   80

Leu Ala Val Gln Ser Gln Glu Glu Leu Phe Arg Phe Gly Arg Ser Lys
                85   90   95

Gly Val Lys Val Arg Ser Val Tyr Gly Gly Ser Ser Ile Glu Lys Gln
            100   105   110

Ile Lys Ala Leu Lys Ser Gly Ala His Ile Val Val Gly Thr Pro Gly
        115   120   125

Arg Leu Leu Asp Leu Ile Lys Arg Lys Ala Leu Lys Leu Gln Asp Ile
    130   135   140

Glu Thr Leu Ile Leu Asp Glu Ala Asp Glu Met Leu Asn Met Gly Phe
145   150   155   160

Leu Glu Asp Ile Glu Ala Ile Ile Ser Arg Val Pro Glu Asn Arg Gln
                165   170   175

Thr Leu Leu Phe Ser Ala Thr Met Pro Asp Ala Ile Lys Arg Ile Gly
            180   185   190

Val Gln Phe Met Lys Ala Pro Glu His Val Lys Ile Ala Ala Lys Glu
195 200 205

Leu Thr Thr Glu Leu Val Asp Gln Tyr Tyr Ile Arg Val Lys Glu Gln
210 215 220

Glu Lys Phe Asp Thr Met Thr Arg Leu Met Asp Val Ala Gln Pro Glu
225 230 235 240

Leu Ala Ile Val Phe Gly Arg Thr Lys Arg Arg Val Asp Glu Leu Thr
245 250 255

Arg Gly Leu Lys Ile Arg Gly Phe Arg Ala Glu Gly Ile His Gly Asp
260 265 270

Leu Asp Gln Asn Lys Arg Leu Arg Val Leu Arg Asp Phe Lys Asn Gly
275 280 285

Asn Leu Asp Val Leu Val Ala Thr Asp Val Ala Ala Arg Gly Leu Asp
290 295 300

Ile Ser Gly Val Thr His Val Tyr Asn Tyr Asp Ile Pro Gln Asp Pro
305 310 315 320

Glu Ser Tyr Val His Arg Ile Gly Arg Thr Gly Arg Ala Gly Lys Ser
325 330 335

Gly Gln Ser Ile Thr Phe Val Ala Pro Asn Glu Met Gly Tyr Leu Gln
340 345 350

Ile Ile Glu Asn Leu Thr Lys Lys Arg Met Lys Gly Leu Lys Pro Ala
355 360 365

Ser Val Glu Glu Ser Phe Gln Ser Lys Lys Gln Val Ala Leu Lys Lys
370 375 380

Ile Glu Arg Asp Phe Ala Asp Glu Thr Ile Arg Ala Asn Phe Glu Lys
385 390 395 400

Phe Gly Lys Asp Ala Arg Lys Leu Ala Ala Glu Phe Thr Pro Glu Glu
405 410 415

Leu Ala Met Tyr Ile Leu Ser Leu Thr Val Gln Asp Pro Asp Ser Leu
420 425 430

Pro Glu Val Glu Ile Ala Arg Glu Lys Pro Leu Pro Phe Lys Pro Ser
435 440 445

Gly Asn Gly Phe Gly Gly Lys Ala Lys Gly Gly Arg Gly Gly Arg Arg
450 455 460

Gly Asp Asp Arg Arg Glu Arg Asp Arg Arg Gly Asn Gly Arg Arg Asp
465 470 475 480

Glu Phe Lys Lys Gly Ser Arg Gly Asn Asp Arg Phe Asp Lys Glu Lys
485 490 495

Arg Tyr Arg Lys Asp Asn Lys Lys Pro Arg Asn Thr Leu Ser Glu Lys
500 505 510

Gln Thr Gly Phe Val Ile Arg Asn Lys Gly Asp Lys
515 520

<210> 703
<211> 438
<212> PRT
<213> Streptococcus pneumoniae

<400> 703

Met Leu Thr Tyr Asp Leu Ile Val Ile Gly Phe Gly Lys Ala Gly Lys
1 5 10 15

Thr Leu Ala Gly Lys Leu Ala Ser Ala Gly Lys Lys Val Ala Leu Val
20 25 30

Glu Arg Ser Lys Ala Met Tyr Gly Gly Thr Cys Ile Asn Ile Gly Cys
35 40 45

Ile Pro Thr Lys Thr Leu Leu Val Ala Ala Glu Lys Asp Leu Ser Phe
50 55 60

Glu Glu Val Ile Ala Thr Lys Asn Thr Ile Thr Gly Arg Leu Asn Gly
65 70 75 80

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Lys Asn Tyr Ala Thr Val Ala Gly Thr Gly Val Asp Ile Phe Asp Ala
                85                  90                  95

Glu Ala His Phe Leu Ser Asn Lys Val Ile Glu Ile Gln Ala Gly Asp
            100                 105                 110

Glu Lys Lys Glu Leu Thr Ala Glu Thr Ile Val Ile Asn Thr Gly Ala
        115                 120                 125

Val Ser Asn Val Leu Pro Ile Pro Gly Leu Ala Thr Ser Lys Asn Ile
    130                 135                 140

Phe Asp Ser Thr Gly Ile Gln Ser Leu Asp Lys Leu Pro Glu Lys Leu
145                 150                 155                 160

Gly Ile Leu Gly Gly Gly Asn Ile Gly Leu Glu Phe Ala Gly Leu Tyr
                165                 170                 175

Asn Lys Leu Gly Ser Lys Val Thr Val Leu Asp Ala Leu Asp Thr Phe
            180                 185                 190

Leu Pro Arg Ala Glu Pro Ser Ile Ala Ala Leu Ala Lys Gln Tyr Met
        195                 200                 205

Glu Glu Asp Gly Ile Glu Leu Leu Gln Asn Ile His Thr Thr Glu Ile
    210                 215                 220

Lys Asn Asp Gly Asp Gln Val Leu Val Val Thr Glu Asp Glu Thr Tyr
225                 230                 235                 240

Arg Phe Asp Ala Leu Leu Tyr Ala Thr Gly Arg Lys Pro Asn Val Glu
                245                 250                 255

Pro Leu Gln Leu Glu Asn Thr Asp Ile Glu Leu Thr Glu Arg Gly Ala
            260                 265                 270

Ile Lys Val Asp Lys His Cys Gln Thr Asn Val Pro Gly Val Phe Ala
        275                 280                 285

Val Gly Asp Val Asn Gly Gly Leu Gln Phe Thr Tyr Ile Ser Leu Asp
```

290 295 300

Asp Phe Arg Val Val Tyr Ser Tyr Leu Ala Gly Asp Gly Ser Tyr Thr
305 310 315 320

Leu Glu Asp Arg Leu Asn Val Pro Asn Thr Met Phe Ile Thr Pro Ala
325 330 335

Leu Ser Gln Val Gly Leu Thr Glu Ser Gln Ala Ala Asp Leu Lys Leu
340 345 350

Pro Tyr Ala Val Lys Glu Ile Pro Val Ala Ala Met Pro Arg Gly His
355 360 365

Val Asn Gly Asp Leu Arg Gly Ala Phe Lys Ala Val Val Asn Thr Glu
370 375 380

Thr Lys Glu Ile Leu Gly Ala Ser Ile Phe Ser Glu Gly Ser Gln Glu
385 390 395 400

Ile Ile Asn Ile Ile Thr Val Ala Met Asp Asn Lys Ile Pro Tyr Thr
405 410 415

Tyr Phe Thr Lys Gln Ile Phe Thr His Pro Thr Leu Ala Glu Asn Leu
420 425 430

Asn Asp Leu Phe Ala Ile
435

<210> 704
<211> 778
<212> PRT
<213> Streptococcus pneumoniae

<400> 704

Met Asp Lys Asn Lys Ile Met Gly Leu Thr Gln Arg Glu Val Lys Glu
1 5 10 15

Arg Gln Ala Glu Gly Leu Val Asn Asp Phe Thr Ala Ser Ala Ser Thr
20 25 30

Ser Thr Trp Gln Ile Val Lys Arg Asn Val Phe Thr Leu Phe Asn Ala

```
        35                  40                  45

Leu Asn Phe Ala Ile Ala Leu Ala Leu Ala Phe Val Gln Ala Trp Ser
    50                  55                  60

Asn Leu Val Phe Phe Ala Val Ile Cys Phe Asn Ala Phe Ser Gly Ile
65                  70                  75                  80

Val Thr Glu Leu Arg Ala Lys His Met Val Asp Lys Leu Asn Leu Met
                85                  90                  95

Thr Lys Glu Lys Val Lys Thr Ile Arg Asp Gly Gln Glu Val Ala Leu
            100                 105                 110

Asn Pro Glu Glu Leu Val Leu Gly Asp Val Ile Arg Leu Ser Ala Gly
        115                 120                 125

Glu Gln Ile Pro Ser Asp Ala Leu Val Leu Glu Gly Phe Ala Glu Val
    130                 135                 140

Asn Glu Ala Met Leu Thr Gly Glu Ser Asp Leu Val Gln Lys Glu Val
145                 150                 155                 160

Asp Gly Leu Leu Leu Ser Gly Ser Phe Leu Ala Ser Gly Ser Val Leu
                165                 170                 175

Ser Gln Val His His Val Gly Ala Asp Asn Tyr Ala Ala Lys Leu Met
            180                 185                 190

Leu Glu Ala Lys Thr Val Lys Pro Ile Asn Ser Arg Ile Met Lys Ser
        195                 200                 205

Leu Asp Lys Leu Ala Gly Phe Thr Gly Lys Ile Ile Ile Pro Phe Gly
    210                 215                 220

Leu Ala Leu Leu Leu Glu Ala Leu Leu Leu Lys Gly Leu Pro Leu Lys
225                 230                 235                 240

Ser Ser Val Val Asn Ser Ser Thr Ala Leu Leu Gly Met Leu Pro Lys
                245                 250                 255
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Gly Ile Ala Leu Leu Thr Ile Thr Ser Leu Leu Thr Ala Val Ile Lys
260 265 270

Leu Gly Leu Lys Lys Val Leu Val Gln Glu Met Tyr Ser Val Glu Thr
275 280 285

Leu Ala Arg Val Asp Met Leu Cys Leu Asp Lys Thr Gly Thr Ile Thr
290 295 300

Gln Gly Lys Met Gln Val Glu Ala Val Leu Pro Leu Thr Glu Thr Tyr
305 310 315 320

Gly Glu Glu Ala Ile Ala Ser Ile Leu Thr Ser Tyr Met Ala His Ser
325 330 335

Glu Asp Lys Asn Pro Thr Ala Gln Ala Ile Arg Gln Arg Phe Val Gly
340 345 350

Asp Val Ala Tyr Pro Met Ile Ser Asn Leu Pro Phe Ser Ser Asp Arg
355 360 365

Lys Trp Gly Ala Met Glu Leu Glu Gly Leu Gly Thr Val Phe Leu Gly
370 375 380

Ala Pro Glu Met Leu Leu Asp Ser Glu Val Pro Glu Ala Arg Glu Ala
385 390 395 400

Leu Glu Arg Gly Ser Arg Val Leu Val Leu Ala Leu Ser Gln Glu Lys
405 410 415

Leu Asp His His Lys Pro Gln Lys Pro Ser Asp Ile Gln Ala Leu Ala
420 425 430

Leu Leu Glu Ile Leu Asp Pro Ile Arg Glu Gly Ala Ala Glu Thr Leu
435 440 445

Asp Tyr Leu Arg Ser Gln Glu Val Gly Leu Lys Ile Ile Ser Gly Asp
450 455 460

Asn Pro Val Thr Val Ser Ser Ile Ala Gln Lys Ala Gly Phe Ala Asp
465 470 475 480

Tyr His Ser Tyr Val Asp Cys Ser Lys Ile Thr Asp Glu Glu Leu Met
485 490 495

Ala Met Ala Glu Glu Thr Ala Ile Phe Gly Arg Val Ser Pro His Gln
500 505 510

Lys Lys Leu Ile Ile Gln Thr Leu Lys Lys Ala Gly His Thr Thr Ala
515 520 525

Met Thr Gly Asp Gly Val Asn Asp Ile Leu Ala Leu Arg Glu Ala Asp
530 535 540

Cys Ser Ile Val Met Ala Glu Gly Asp Pro Ala Thr Arg Gln Ile Ala
545 550 555 560

Asn Leu Val Leu Leu Asn Ser Asp Phe Asn Asp Val Pro Glu Ile Leu
565 570 575

Phe Glu Gly Arg Arg Val Val Asn Asn Ile Ala His Ile Ala Pro Ile
580 585 590

Phe Leu Ile Lys Thr Ile Tyr Ser Phe Leu Leu Ala Val Ile Cys Ile
595 600 605

Ala Ser Ala Leu Leu Gly Arg Ser Glu Trp Ile Leu Ile Phe Pro Phe
610 615 620

Ile Pro Ile Gln Ile Thr Met Ile Asp Gln Phe Val Glu Gly Phe Pro
625 630 635 640

Pro Phe Val Leu Thr Phe Glu Arg Asn Ile Lys Pro Val Glu Gln Asn
645 650 655

Phe Leu Arg Lys Ser Met Leu Arg Ala Leu Pro Ser Ala Leu Met Val
660 665 670

Val Phe Ser Val Leu Phe Val Lys Met Phe Gly Ala Ser Gln Gly Trp
675 680 685

Ser Glu Leu Glu Ile Ser Thr Leu Leu Tyr Tyr Leu Leu Gly Ser Ile
690 695 700

Gly Phe Leu Ser Val Phe Arg Ala Cys Met Pro Phe Thr Leu Trp Arg
705 710 715 720

Val Leu Leu Ile Val Trp Ser Val Gly Gly Phe Leu Ala Thr Ala Leu
725 730 735

Phe Pro Arg Ile Gln Lys Leu Leu Glu Ile Ser Thr Leu Thr Glu Gln
740 745 750

Thr Leu Pro Val Tyr Gly Val Met Met Leu Val Phe Thr Val Ile Phe
755 760 765

Ile Leu Thr Ser Arg Tyr Gln Ala Lys Lys
770 775

<210> 705
<211> 89
<212> PRT
<213> Streptococcus pneumoniae

<400> 705

Met Ala Ile Ser Lys Glu Lys Lys Asn Glu Ile Ile Ala Gln Tyr Ala
1 5 10 15

Arg His Glu Gly Asp Thr Gly Ser Val Glu Val Gln Val Ala Val Leu
20 25 30

Thr Trp Glu Ile Asn His Leu Asn Glu His Ile Lys Gln His Lys Lys
35 40 45

Asp His Ala Thr Tyr Arg Gly Leu Met Lys Lys Ile Gly Arg Arg Arg
50 55 60

Asn Leu Leu Ala Tyr Leu Arg Lys Asn Asp Val Asn Arg Tyr Arg Glu
65 70 75 80

Leu Ile Asn Ser Leu Gly Leu Arg Arg
85

<210> 706
<211> 630

<212> PRT
<213> Streptococcus pneumoniae

<400> 706

Met Thr Arg Tyr Gln Asp Asp Phe Tyr Asp Ala Ile Asn Gly Glu Trp
1 5 10 15

Gln Gln Thr Ala Glu Ile Pro Ala Asp Lys Ser Gln Thr Gly Gly Phe
20 25 30

Val Asp Leu Asp Gln Glu Ile Glu Asp Leu Met Leu Ala Thr Thr Asp
35 40 45

Lys Trp Leu Ala Gly Glu Glu Val Pro Glu Asp Ala Ile Leu Glu Asn
50 55 60

Phe Val Lys Tyr His Arg Leu Val Arg Asp Phe Asp Lys Arg Glu Ala
65 70 75 80

Asp Gly Ile Thr Pro Val Leu Pro Leu Leu Lys Glu Phe Gln Glu Leu
85 90 95

Glu Thr Phe Ala Asp Phe Thr Ala Lys Leu Ala Glu Phe Glu Leu Ala
100 105 110

Gly Lys Pro Asn Phe Leu Pro Phe Gly Val Ser Pro Asp Phe Met Asp
115 120 125

Ala Arg Ile Asn Val Leu Trp Ala Ser Ala Pro Ser Thr Ile Leu Pro
130 135 140

Asp Thr Thr Tyr Tyr Ala Glu Glu His Pro Gln Arg Glu Glu Leu Leu
145 150 155 160

Thr Leu Trp Lys Glu Ser Ser Ala Asn Leu Leu Lys Ala Tyr Asp Phe
165 170 175

Ser Asp Glu Glu Ile Glu Asp Leu Leu Glu Lys Arg Leu Glu Leu Asp
180 185 190

Arg Arg Val Ala Ala Val Val Leu Ser Asn Glu Glu Ser Ser Glu Tyr
195 200 205

Ala Lys Leu Tyr His Pro Tyr Ser Tyr Glu Asp Phe Lys Lys Phe Ala
210 215 220

Pro Ala Leu Pro Leu Asp Asp Phe Phe Lys Ala Val Ile Gly Gln Leu
225 230 235 240

Pro Asp Lys Val Ile Val Asp Glu Glu Arg Phe Trp Gln Ala Ala Glu
245 250 255

Gln Phe Tyr Ser Glu Glu Ala Trp Ser Leu Leu Lys Ala Thr Leu Ile
260 265 270

Leu Ser Val Val Asn Leu Ser Thr Ser Tyr Leu Thr Glu Asp Ile Arg
275 280 285

Val Leu Ser Gly Ala Tyr Ser Arg Ala Leu Ser Gly Val Pro Glu Ala
290 295 300

Lys Asp Lys Val Lys Ala Ala Tyr His Leu Ala Gln Glu Pro Phe Lys
305 310 315 320

Gln Ala Leu Gly Leu Trp Tyr Ala Arg Glu Lys Phe Ser Pro Glu Ala
325 330 335

Lys Ala Asp Val Glu Lys Lys Val Ala Thr Met Ile Asp Val Tyr Lys
340 345 350

Glu Arg Leu Leu Lys Asn Asp Trp Leu Thr Pro Glu Thr Cys Lys Gln
355 360 365

Ala Ile Val Lys Leu Asn Val Ile Lys Pro Tyr Ile Gly Tyr Pro Glu
370 375 380

Glu Leu Pro Ala Arg Tyr Lys Asp Lys Val Val Asn Glu Thr Ala Ser
385 390 395 400

Leu Phe Glu Asn Ala Leu Ala Phe Ala Arg Val Glu Ile Lys His Ser
405 410 415

Trp Ser Lys Trp Asn Gln Pro Val Asp Tyr Lys Glu Trp Gly Met Pro

```
            420                     425                     430

Ala His Met Val Asn Ala Tyr Tyr Asn Pro Gln Lys Asn Leu Ile Val
        435                 440                     445

Phe Pro Ala Ala Ile Leu Gln Ala Pro Phe Tyr Asp Leu His Gln Ser
    450                 455                     460

Ser Ser Ala Asn Tyr Gly Gly Ile Gly Ala Val Ile Ala His Glu Ile
465                 470                     475                 480

Ser His Ala Phe Asp Thr Asn Gly Ala Ser Phe Asp Glu Asn Gly Ser
                485                     490                 495

Leu Lys Asp Trp Trp Thr Glu Ser Asp Tyr Ala Ala Phe Lys Glu Lys
            500                     505                 510

Thr Gln Lys Val Ile Asp Gln Phe Asp Gly Gln Asp Ser Tyr Gly Ala
        515                 520                     525

Thr Ile Asn Gly Lys Leu Thr Val Ser Glu Asn Val Ala Asp Leu Gly
    530                 535                     540

Gly Ile Ala Ala Ala Leu Glu Ala Ala Lys Arg Glu Ala Asp Phe Ser
545                 550                     555                 560

Ala Glu Glu Phe Phe Tyr Asn Phe Gly Arg Ile Trp Arg Met Lys Gly
                565                     570                 575

Arg Pro Glu Phe Met Lys Leu Leu Ala Ser Val Asp Val His Ala Pro
            580                     585                 590

Ala Lys Leu Arg Val Asn Val Gln Val Pro Asn Phe Asp Asp Phe Phe
        595                 600                     605

Thr Thr Tyr Asp Val Lys Glu Gly Asp Gly Met Trp Arg Ser Pro Glu
    610                 615                     620

Glu Arg Val Ile Ile Trp
625                 630
```

<210> 707
<211> 230
<212> PRT
<213> Streptococcus pneumoniae

<400> 707

Met Val Lys Leu Val Phe Ala Arg His Gly Glu Ser Glu Trp Asn Lys
1 5 10 15

Ala Asn Leu Phe Thr Gly Trp Ala Asp Val Asp Leu Ser Glu Lys Gly
20 25 30

Thr Gln Gln Ala Ile Asp Ala Gly Lys Leu Ile Lys Glu Ala Gly Ile
35 40 45

Glu Phe Asp Gln Ala Tyr Thr Ser Val Leu Lys Arg Ala Ile Lys Thr
50 55 60

Thr Asn Leu Ala Leu Glu Ala Ser Asp Gln Leu Trp Val Pro Val Glu
65 70 75 80

Lys Ser Trp Arg Leu Asn Glu Arg His Tyr Gly Gly Leu Thr Gly Lys
85 90 95

Asn Lys Ala Glu Ala Ala Glu Gln Phe Gly Asp Glu Gln Val His Ile
100 105 110

Trp Arg Arg Ser Tyr Asp Val Leu Pro Pro Asn Met Asp Arg Asp Asp
115 120 125

Glu His Ser Ala His Thr Asp Arg Arg Tyr Ala Ser Leu Asp Asp Ser
130 135 140

Val Ile Pro Asp Ala Glu Asn Leu Lys Val Thr Leu Glu Arg Ala Leu
145 150 155 160

Pro Phe Trp Glu Asp Lys Ile Ala Pro Ala Leu Lys Asp Gly Lys Asn
165 170 175

Val Phe Val Gly Ala His Gly Asn Ser Ile Arg Ala Leu Val Lys His
180 185 190

Ile Lys Gly Leu Ser Asp Asp Glu Ile Met Asp Val Glu Ile Pro Asn
195 200 205

Phe Pro Pro Leu Val Phe Glu Phe Asp Glu Lys Leu Asn Val Val Ser
210 215 220

Glu Tyr Tyr Leu Gly Lys
225 230

<210> 708
<211> 179
<212> PRT
<213> Streptococcus pneumoniae

<400> 708

Met Ser Leu Lys Asp Arg Phe Asp Arg Phe Ile Asp Tyr Phe Thr Glu
1 5 10 15

Asp Glu Asp Ser Ser Leu Pro Tyr Glu Lys Arg Asp Glu Pro Val Phe
20 25 30

Thr Ser Val Asn Ser Ser Gln Glu Pro Ala Leu Pro Met Asn Gln Pro
35 40 45

Ser Gln Ser Ala Gly Thr Lys Glu Asn Asn Ile Thr Arg Leu His Ala
50 55 60

Arg Gln Gln Glu Leu Ala Asn Gln Ser Gln Arg Ala Thr Asp Lys Val
65 70 75 80

Ile Ile Asp Val Arg Tyr Pro Arg Lys Tyr Glu Asp Ala Thr Glu Ile
85 90 95

Val Asp Leu Leu Ala Gly Asn Glu Ser Ile Leu Ile Asp Phe Gln Tyr
100 105 110

Met Thr Glu Val Gln Ala Arg Arg Cys Leu Asp Tyr Leu Asp Gly Ala
115 120 125

Cys His Val Leu Ala Gly Asn Leu Lys Lys Val Ala Ser Thr Met Tyr
130 135 140

Leu Leu Thr Pro Val Asn Val Ile Val Asn Val Glu Asp Ile Arg Leu
145 150 155 160

Pro Asp Glu Asp Gln Gln Gly Glu Phe Gly Phe Asp Met Lys Arg Asn
165 170 175

Arg Val Arg

<210> 709
<211> 457
<212> PRT
<213> Streptococcus pneumoniae

<400> 709

Met Ala Arg Glu Gly Phe Phe Thr Gly Leu Asp Ile Gly Thr Ser Ser
1 5 10 15

Val Lys Val Leu Val Ala Glu Gln Arg Asn Gly Glu Leu Asn Val Ile
20 25 30

Gly Val Ser Asn Ala Lys Ser Lys Gly Val Lys Asp Gly Ile Ile Val
35 40 45

Asp Ile Asp Ala Ala Ala Thr Ala Ile Lys Ser Ala Ile Ser Gln Ala
50 55 60

Glu Glu Lys Ala Gly Ile Ser Ile Lys Ser Val Asn Val Gly Leu Pro
65 70 75 80

Gly Asn Leu Leu Gln Val Glu Pro Thr Gln Gly Met Ile Pro Val Thr
85 90 95

Ser Asp Thr Lys Glu Ile Thr Asp Gln Asp Val Glu Asn Val Val Lys
100 105 110

Ser Ala Leu Thr Lys Ser Met Thr Pro Asp Arg Glu Val Ile Thr Phe
115 120 125

Ile Pro Glu Glu Phe Ile Val Asp Gly Phe Gln Gly Ile Arg Asp Pro
130 135 140

Arg Gly Met Met Gly Val Arg Leu Glu Met Arg Gly Leu Leu Tyr Thr
145 150 155 160

Gly Pro Arg Thr Ile Leu His Asn Leu Arg Lys Thr Val Glu Arg Ala
165 170 175

Gly Val Gln Val Glu Asn Val Ile Ile Ser Pro Leu Ala Met Val Gln
180 185 190

Ser Val Leu Asn Glu Gly Glu Arg Glu Phe Gly Ala Thr Val Ile Asp
195 200 205

Met Gly Ala Gly Gln Thr Thr Val Ala Thr Ile Arg Asn Gln Glu Leu
210 215 220

Gln Phe Thr His Ile Leu Gln Glu Gly Gly Asp Tyr Val Thr Lys Asp
225 230 235 240

Ile Ser Lys Val Leu Lys Thr Ser Arg Lys Leu Ala Glu Gly Leu Lys
245 250 255

Leu Asn Tyr Gly Glu Ala Tyr Pro Pro Leu Ala Ser Lys Glu Thr Phe
260 265 270

Gln Val Glu Val Ile Gly Glu Val Glu Ala Val Glu Val Thr Glu Ala
275 280 285

Tyr Leu Ser Glu Ile Ile Ser Ala Arg Ile Lys His Ile Leu Glu Gln
290 295 300

Ile Lys Gln Glu Leu Asp Arg Arg Arg Leu Leu Asp Leu Pro Gly Gly
305 310 315 320

Ile Val Leu Ile Gly Gly Asn Ala Ile Leu Pro Gly Met Val Glu Leu
325 330 335

Ala Gln Glu Val Phe Gly Val Arg Val Lys Leu Tyr Val Pro Asn Gln
340 345 350

Val Gly Ile Arg Asn Pro Ala Phe Ala His Val Ile Ser Leu Ser Glu
355 360 365

Phe Ala Gly Gln Leu Thr Glu Val Asn Leu Leu Ala Gln Gly Ala Ile
    370   375   380

Lys Gly Glu Asn Asp Leu Ser His Gln Pro Ile Ser Phe Gly Gly Met
385   390   395   400

Leu Gln Lys Thr Ala Gln Phe Val Gln Ser Thr Pro Val Gln Pro Ala
                405   410   415

Pro Ala Pro Glu Val Glu Pro Val Ala Pro Thr Glu Pro Met Ala Asp
            420   425   430

Phe Gln Gln Ala Ser Gln Asn Lys Pro Lys Leu Ala Asp Arg Phe Arg
        435   440   445

Gly Leu Ile Gly Ser Met Phe Asp Glu
    450   455

<210> 710
<211> 685
<212> PRT
<213> Streptococcus pneumoniae

<400> 710

Met Arg Leu Ile Cys Met Arg Lys Phe Asn Ser His Ser Ile Pro Ile
1   5   10   15

Arg Leu Asn Leu Leu Phe Ser Ile Val Ile Leu Leu Phe Met Thr Ile
            20   25   30

Ile Gly Arg Leu Leu Tyr Met Gln Val Leu Asn Lys Asp Phe Tyr Glu
        35   40   45

Lys Lys Leu Ala Ser Ala Ser Gln Thr Lys Ile Thr Ser Ser Ser Ala
    50   55   60

Arg Gly Glu Ile Tyr Asp Ala Ser Gly Lys Pro Leu Val Glu Asn Thr
65   70   75   80

Leu Lys Gln Val Val Ser Phe Thr Arg Ser Asn Lys Met Thr Ala Thr
                85   90   95

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Asp Leu Lys Glu Thr Ala Lys Lys Leu Leu Thr Tyr Val Ser Ile Ser
            100                 105                 110

Ser Pro Asn Leu Thr Glu Arg Gln Leu Ala Asp Tyr Tyr Leu Ala Asp
        115                 120                 125

Pro Glu Ile Tyr Lys Lys Ile Val Glu Ala Leu Pro Ser Glu Lys Arg
    130                 135                 140

Leu Asp Ser Asp Gly Asn Arg Leu Ser Glu Ser Glu Leu Tyr Asn Asn
145                 150                 155                 160

Ala Val Asp Ser Val Gln Thr Ser Gln Leu Asn Tyr Thr Glu Asp Glu
                165                 170                 175

Lys Lys Glu Ile Tyr Leu Phe Ser Gln Leu Asn Ala Val Gly Asn Phe
            180                 185                 190

Ala Thr Gly Thr Ile Ala Thr Asp Pro Leu Asn Asp Ser Gln Val Ala
        195                 200                 205

Val Ile Ala Ser Ile Ser Lys Glu Met Pro Gly Ile Ser Ile Ser Thr
    210                 215                 220

Ser Trp Asp Arg Lys Val Leu Glu Thr Ser Leu Ser Ser Ile Val Gly
225                 230                 235                 240

Ser Val Ser Ser Glu Lys Ala Gly Leu Pro Ala Glu Glu Ala Glu Ala
                245                 250                 255

Tyr Leu Lys Lys Gly Tyr Ser Leu Asn Asp Arg Val Gly Thr Ser Tyr
            260                 265                 270

Leu Glu Lys Gln Tyr Glu Glu Thr Leu Gln Gly Lys Arg Ser Val Lys
        275                 280                 285

Glu Ile His Leu Asp Lys Tyr Gly Asn Met Glu Ser Val Asp Thr Ile
    290                 295                 300

Glu Glu Gly Ser Lys Gly Asn Asn Ile Lys Leu Thr Ile Asp Leu Ala
305                 310                 315                 320
```

Phe Gln Asp Ser Val Asp Ala Leu Leu Lys Ser Tyr Phe Asn Ser Glu
                325   330   335

Leu Glu Asn Gly Gly Ala Lys Tyr Ser Glu Gly Val Tyr Ala Val Ala
            340   345   350

Leu Asn Pro Lys Thr Gly Ala Val Leu Ser Met Ser Gly Ile Lys His
        355   360   365

Asp Leu Lys Thr Gly Glu Leu Thr Pro Asp Ser Leu Gly Thr Val Thr
    370   375   380

Asn Val Phe Val Pro Gly Ser Val Val Lys Ala Ala Thr Ile Ser Ser
385   390   395   400

Gly Trp Glu Asn Gly Val Leu Ser Gly Asn Gln Thr Leu Thr Asp Gln
                405   410   415

Ser Ile Val Phe Gln Gly Ser Ala Pro Ile Asn Ser Trp Tyr Thr Gln
            420   425   430

Ala Tyr Gly Ser Phe Pro Ile Thr Ala Val Gln Ala Leu Glu Tyr Ser
        435   440   445

Ser Asn Thr Tyr Met Val Gln Thr Ala Leu Gly Leu Met Gly Gln Thr
    450   455   460

Tyr Gln Pro Asn Met Phe Val Gly Thr Ser Asn Leu Glu Ser Ala Met
465   470   475   480

Glu Lys Leu Arg Ser Thr Phe Gly Glu Tyr Gly Leu Gly Thr Ala Thr
                485   490   495

Gly Ile Asp Leu Pro Asp Glu Ser Thr Gly Phe Val Pro Lys Glu Tyr
            500   505   510

Ser Phe Ala Asn Tyr Ile Thr Asn Ala Phe Gly Gln Phe Asp Asn Tyr
        515   520   525

Thr Pro Met Gln Leu Ala Gln Tyr Val Ala Thr Ile Ala Asn Asn Gly

530 535 540

Val Arg Val Ala Pro Arg Ile Val Glu Gly Ile Tyr Gly Asn Asn Asp
545 550 555 560

Lys Gly Gly Leu Gly Asp Leu Ile Gln Gln Leu Gln Pro Thr Glu Met
565 570 575

Asn Lys Val Asn Ile Ser Asp Ser Asp Met Ser Ile Leu His Gln Gly
580 585 590

Phe Tyr Gln Val Ala His Gly Thr Ser Gly Leu Thr Thr Gly Arg Ala
595 600 605

Phe Ser Asn Gly Ala Leu Val Ser Ile Ser Gly Lys Thr Gly Thr Ala
610 615 620

Glu Ser Tyr Val Ala Asp Gly Gln Gln Ala Thr Asn Thr Asn Ala Val
625 630 635 640

Ala Tyr Ala Pro Ser Asp Asn Pro Gln Ile Ala Val Ala Val Val Phe
645 650 655

Pro His Asn Thr Asn Leu Thr Asn Gly Val Gly Pro Ser Ile Ala Arg
660 665 670

Asp Ile Ile Asn Leu Tyr Gln Lys Tyr His Pro Met Asn
675 680 685

<210> 711
<211> 301
<212> PRT
<213> Streptococcus pneumoniae

<400> 711

Met Ser Glu Leu Ile Ser Val Val Val Pro Ile Tyr Asn Thr Gly Lys
1 5 10 15

Tyr Leu Val Glu Cys Val Glu His Ile Leu Lys Gln Thr Tyr Gln Asn
20 25 30

Ile Glu Ile Ile Leu Val Asp Asp Gly Ser Thr Asp Asn Ser Gly Glu

35 40 45

Ile Cys Asp Ala Phe Met Met Gln Asp Asn Arg Val Arg Val Leu His
50 55 60

Gln Glu Asn Lys Gly Gly Ala Ala Gln Ala Lys Asn Met Gly Ile Ser
65 70 75 80

Val Ala Lys Gly Glu Tyr Ile Thr Ile Val Asp Ser Asp Asp Ile Val
85 90 95

Lys Glu Asn Met Ile Glu Thr Leu Tyr Gln Gln Val Gln Glu Lys Asp
100 105 110

Ala Asp Val Val Ile Gly Asn Tyr Tyr Asn Tyr Asp Glu Ser Asp Gly
115 120 125

Asn Phe Tyr Phe Tyr Val Thr Gly Gln Asp Phe Cys Val Glu Glu Leu
130 135 140

Ala Ile Gln Glu Ile Met Asn Arg Gln Ala Gly Asp Trp Lys Phe Asn
145 150 155 160

Ser Ser Ala Phe Ile Leu Pro Thr Phe Lys Leu Ile Lys Lys Glu Leu
165 170 175

Phe Asn Glu Val His Phe Ser Asn Gly Arg Arg Phe Asp Asp Glu Ala
180 185 190

Thr Met His Arg Phe Tyr Leu Leu Ala Ser Lys Ile Val Phe Ile Asn
195 200 205

Asp Asn Leu Tyr Leu Tyr Arg Arg Arg Ser Gly Ser Ile Met Arg Thr
210 215 220

Glu Phe Asp Leu Ser Trp Ala Arg Asp Ile Val Glu Val Phe Ser Lys
225 230 235 240

Lys Ile Ser Asp Cys Val Leu Ala Gly Leu Asp Val Ser Val Leu Arg
245 250 255

Ile Arg Phe Val Asn Leu Leu Lys Asp Tyr Lys Gln Thr Leu Glu Tyr
260 265 270

His Gln Leu Thr Asp Thr Glu Glu Tyr Lys Asp Ile Cys Phe Arg Leu
275 280 285

Lys Leu Phe Phe Asp Ala Glu Gln Arg Asn Gly Lys Ser
290 295 300

<210> 712
<211> 104
<212> PRT
<213> Streptococcus pneumoniae

<400> 712

Met Ala Lys Ala Ile Thr Asp Ala Thr Phe Glu Gln Glu Thr Lys Asp
1 5 10 15

Gly Leu Val Leu Val Asp Phe Trp Ala Thr Trp Cys Gly Pro Cys Arg
20 25 30

Met Gln Gly Pro Ile Leu Asp Lys Leu Ser Glu Glu Leu Ser Glu Asp
35 40 45

Val Leu Lys Ile Val Lys Met Asp Val Asp Glu Asn Pro Asn Thr Ala
50 55 60

Arg Ala Phe Gly Ile Met Ser Ile Pro Thr Leu Leu Phe Lys Lys Asp
65 70 75 80

Gly Gln Val Val Lys Gln Val Ala Gly Val His Thr Ala Glu Gln Ile
85 90 95

Lys Ala Ile Ile Ala Glu Leu Ser
100

<210> 713
<211> 202
<212> PRT
<213> Streptococcus pneumoniae

<400> 713

Met Ser Asn Glu Lys Asn Thr Asn Thr Asn Val Glu Lys Lys Asp Ala

1 5 10 15

Thr Val Val Ala His Glu Ile Lys Gly Glu Leu Thr Tyr Glu Asp Lys
20 25 30

Val Ile Gln Lys Ile Ile Gly Leu Ser Leu Glu Asn Val Ser Gly Leu
35 40 45

Leu Gly Ile Asp Gly Gly Phe Phe Ser Asn Leu Lys Glu Lys Ile Val
50 55 60

Asn Ser Asp Asp Val Thr Ser Gly Val Asn Val Glu Val Gly Lys Thr
65 70 75 80

Gln Val Ala Val Asp Leu Asn Val Ile Val Glu Tyr Gln Lys Asn Val
85 90 95

Pro Ala Leu Tyr Ser Glu Ile Arg Glu Ile Val Ser Ser Glu Val Ala
100 105 110

Lys Met Thr Asp Leu Glu Ile Val Glu Ile Asn Val Asn Val Val Asp
115 120 125

Ile Lys Thr Lys Glu Gln His Glu Ala Asp Ser Val Ser Leu Gln Asp
130 135 140

Arg Val Ser Asp Val Ala Glu Ser Thr Gly Glu Phe Thr Ser Glu Gln
145 150 155 160

Phe Glu Lys Ala Lys Ser Gly Leu Gly Ser Gly Phe Ser Thr Val Gln
165 170 175

Glu Lys Val Ser Glu Gly Val Glu Ala Val Lys Gly Ala Ala Asn Gly
180 185 190

Val Val Ser His Glu Asn Thr Arg Val Asn
195 200

<210> 714
<211> 583
<212> PRT
<213> Streptococcus pneumoniae

<400> 714

Met Gln Asn Lys Gln Glu Gln Trp Thr Val Leu Lys Arg Leu Met Ser
1 5 10 15

Tyr Leu Lys Pro Tyr Gly Leu Leu Thr Phe Leu Ala Leu Ser Phe Leu
20 25 30

Leu Ala Thr Thr Val Ile Lys Ser Val Ile Pro Leu Val Ala Ser His
35 40 45

Phe Ile Asp Gln Tyr Leu Ser Asn Leu Asn Gln Leu Ala Val Thr Val
50 55 60

Leu Leu Val Tyr Tyr Gly Leu Tyr Ile Leu Gln Thr Val Val Gln Tyr
65 70 75 80

Val Gly Asn Leu Leu Phe Ala Arg Val Ser Tyr Ser Ile Val Arg Asp
85 90 95

Ile Arg Arg Asp Ala Phe Ala Asn Met Glu Lys Leu Gly Met Ser Tyr
100 105 110

Phe Asp Lys Thr Pro Ala Gly Ser Ile Val Ser Arg Leu Thr Asn Asp
115 120 125

Thr Glu Thr Ile Ser Asp Met Phe Ser Gly Ile Leu Ser Ser Phe Ile
130 135 140

Ser Ala Val Phe Ile Phe Leu Thr Thr Leu Tyr Thr Met Leu Val Leu
145 150 155 160

Asp Phe Arg Leu Thr Ala Leu Val Leu Leu Phe Leu Pro Leu Ile Phe
165 170 175

Leu Leu Val Asn Leu Tyr Arg Lys Lys Ser Val Lys Ile Ile Glu Lys
180 185 190

Thr Arg Ser Leu Leu Ser Asp Ile Asn Ser Lys Leu Ala Glu Asn Ile
195 200 205

Glu Gly Ile Arg Ile Ile Gln Ala Phe Asn Gln Glu Lys Arg Leu Gln
210 215 220

Ala Glu Phe Asp Glu Ile Asn Gln Glu His Leu Val Tyr Ala Asn Arg
225 230 235 240

Ser Val Ala Leu Asp Ala Leu Phe Leu Arg Pro Ala Met Ser Leu Leu
245 250 255

Lys Leu Leu Gly Tyr Ala Val Leu Met Ala Tyr Phe Gly Tyr Arg Gly
260 265 270

Phe Ser Ile Gly Ile Thr Val Gly Thr Met Tyr Ala Phe Ile Gln Tyr
275 280 285

Ile Asn Arg Leu Phe Asp Pro Leu Ile Glu Val Thr Gln Asn Phe Ser
290 295 300

Thr Leu Gln Thr Ala Met Val Ser Ala Gly Arg Val Phe Ala Leu Ile
305 310 315 320

Asp Glu Arg Thr Tyr Glu Pro Leu Gln Glu Asn Gly Gln Ala Lys Val
325 330 335

Gln Glu Gly Asn Ile Arg Phe Glu His Val Cys Phe Ser Tyr Asp Gly
340 345 350

Lys His Pro Ile Leu Asp Asp Ile Ser Phe Ser Val Asn Lys Gly Glu
355 360 365

Thr Ile Ala Phe Val Gly His Thr Gly Ser Gly Lys Ser Ser Ile Ile
370 375 380

Asn Val Leu Met Arg Phe Tyr Glu Phe Gln Ser Gly Arg Val Leu Leu
385 390 395 400

Asp Asp Val Asp Ile Arg Asp Phe Ser Gln Glu Glu Leu Arg Lys Asn
405 410 415

Ile Gly Leu Val Leu Gln Glu Pro Phe Leu Tyr His Gly Thr Ile Lys
420 425 430

Ser Asn Ile Ala Met Tyr Gln Glu Thr Ser Asp Glu Gln Val Gln Ala
        435   440   445

Ala Ala Ala Phe Val Asp Ala Asp Ser Phe Ile Gln Glu Leu Pro Gln
    450   455   460

Gly Tyr Asp Ser Pro Val Ser Glu Arg Gly Ser Ser Phe Ser Thr Gly
465   470   475   480

Gln Arg Gln Leu Leu Ala Phe Ala Arg Thr Val Ala Ser Gln Pro Lys
                485   490   495

Ile Leu Ile Leu Asp Glu Ala Thr Ala Asn Ile Asp Ser Glu Thr Glu
            500   505   510

Ser Leu Val Gln Ala Ser Leu Ala Lys Met Arg Gln Gly Arg Thr Thr
        515   520   525

Ile Ala Ile Ala His Arg Leu Ser Thr Ile Gln Asp Ala Asn Cys Ile
    530   535   540

Tyr Val Leu Asp Lys Gly Arg Ile Ile Glu Ser Gly Thr His Glu Glu
545   550   555   560

Leu Leu Ala Leu Gly Gly Thr Tyr His Lys Met Tyr Ser Leu Gln Ala
                565   570   575

Gly Ala Met Ala Asp Thr Leu
            580

<210> 715
<211> 153
<212> PRT
<213> Streptococcus pneumoniae

<400> 715

Met Lys Thr Lys Gln Leu Val Ala Ser Glu Glu Val Tyr Asp Phe Leu
1   5   10   15

Lys Val Ile Trp Pro Asp Tyr Glu Thr Glu Ser Arg Tyr Asp Asn Leu
            20   25   30

Ser Leu Ile Val Cys Thr Leu Ser Asp Pro Asp Cys Val Arg Trp Leu
35 40 45

Ser Glu Asn Met Lys Phe Gly Asp Glu Lys Gln Leu Ala Leu Met Lys
50 55 60

Glu Lys Tyr Gly Trp Glu Val Gly Asp Lys Leu Pro Glu Trp Leu His
65 70 75 80

Ser Ser Tyr His Arg Leu Leu Leu Ile Gly Glu Leu Leu Glu Ser Asn
85 90 95

Leu Lys Leu Lys Lys Tyr Thr Val Glu Ile Thr Glu Thr Leu Ser Arg
100 105 110

Leu Val Ser Ile Glu Ala Glu Asn Pro Asp Glu Ala Glu Arg Leu Val
115 120 125

Arg Glu Lys Tyr Lys Ser Cys Glu Ile Val Leu Asp Ala Asp Asp Phe
130 135 140

Gln Asp Tyr Asp Thr Ser Ile Tyr Glu
145 150

<210> 716
<211> 336
<212> PRT
<213> Streptococcus pneumoniae

<400> 716

Met Ala Gly Lys Arg Asp Ser Cys Gly Ala Cys Arg Ile Met Thr Asn
1 5 10 15

Lys Ile Tyr Glu Tyr Lys Asp Asp Gln Asp Trp Tyr Val Gly Ser Tyr
20 25 30

Ser Ile Phe Gly Gly Val Asn Ser Leu Ser Asp Tyr Lys Thr Asp Phe
35 40 45

Pro Leu Phe Glu Phe Ser Lys Ile Phe Gly Asp Glu Glu Tyr Gly Phe
50 55 60

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Pro Leu Ser Val Thr Val Leu Arg Tyr Gly Ser Ile Tyr Arg Leu Phe
65                  70                  75                  80

Ser Phe Val Val Asp Met Leu Asn Gln Glu Met Gly Arg Asn Leu Glu
                85                  90                  95

Val Ile Gln Arg His Gly Ala Leu Leu Leu Val Glu Asn Gly Gln Leu
            100                 105                 110

Leu Tyr Val Glu Leu Pro Lys Glu Gly Val Asn Val His Asp Phe Phe
        115                 120                 125

Glu Thr Ser Lys Val Arg Glu Thr Leu Leu Ile Ala Thr Arg Asn Glu
    130                 135                 140

Gly Lys Thr Lys Glu Phe Arg Ala Ile Phe Asp Lys Leu Gly Tyr Asp
145                 150                 155                 160

Val Glu Asn Leu Asn Asp Tyr Pro Asp Leu Pro Glu Val Ala Glu Thr
                165                 170                 175

Gly Met Thr Phe Glu Glu Asn Ala Arg Leu Lys Ala Glu Thr Ile Ser
            180                 185                 190

Gln Leu Thr Gly Lys Met Val Leu Ala Asp Asp Ser Gly Leu Lys Val
        195                 200                 205

Asp Val Leu Gly Gly Leu Pro Gly Val Trp Ser Ala Arg Phe Ala Gly
    210                 215                 220

Val Gly Ala Thr Asp Arg Glu Asn Asn Ala Lys Leu Leu His Glu Leu
225                 230                 235                 240

Ala Met Val Phe Glu Leu Lys Asp Arg Ser Ala Gln Phe His Thr Thr
                245                 250                 255

Leu Val Val Ala Ser Pro Asn Lys Glu Ser Leu Val Val Glu Ala Asp
            260                 265                 270

Trp Ser Gly Tyr Ile Asn Phe Glu Pro Lys Gly Glu Asn Gly Phe Gly
        275                 280                 285
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Tyr Asp Pro Leu Phe Leu Val Gly Glu Thr Gly Glu Ser Ser Ala Glu
    290   295   300

Leu Thr Leu Glu Glu Lys Asn Ser Gln Ser His Arg Ala Leu Ala Val
305   310   315   320

Lys Lys Leu Leu Glu Val Phe Pro Ser Trp Gln Ser Lys Pro Ser Leu
                325   330   335

<210> 717
<211> 100
<212> PRT
<213> Streptococcus pneumoniae

<400> 717

Met Ala Ser Leu Trp Tyr Asn Glu Arg Asp Ser Lys Arg Asn Arg Arg
1   5   10   15

Lys Met Met Asp Leu Leu Leu Ala Ile Val Leu Ile Val Leu Ala Phe
            20   25   30

Leu Gly Gly Ala Leu Gly Gly Met Tyr Leu Val Arg Lys Gln Ile Glu
        35   40   45

Lys Glu Phe Ala Asp Asn Pro Arg Leu Asn Ala Glu Ala Val Arg Thr
    50   55   60

Leu Leu Ser Ala Asn Gly Gln Lys Pro Ser Glu Ala Lys Val Gln Gln
65   70   75   80

Val Tyr His Gln Ile Ile Arg Gln Gln Lys Ala Ala Leu Ala Asn Asn
                85   90   95

Lys Lys Lys Lys
            100

<210> 718
<211> 94
<212> PRT
<213> Streptococcus pneumoniae

<400> 718

Met Leu Lys Pro Leu Gly Asp Arg Val Val Leu Lys Ile Glu Glu Lys
1 5 10 15

Glu Gln Thr Val Gly Gly Phe Val Leu Ala Gly Ser Ala Gln Glu Lys
20 25 30

Thr Lys Thr Ala Gln Val Val Ala Thr Gly Gln Gly Val Arg Thr Leu
35 40 45

Asn Gly Asp Leu Val Ala Pro Ser Val Lys Thr Gly Asp Arg Val Leu
50 55 60

Val Glu Ala His Ala Gly Leu Asp Val Lys Asp Gly Asp Glu Lys Tyr
65 70 75 80

Ile Ile Val Gly Glu Ala Asn Ile Leu Ala Ile Ile Glu Glu
85 90

<210> 719
<211> 158
<212> PRT
<213> Streptococcus pneumoniae

<400> 719

Met Lys Gly Val Thr Asn Met Thr Pro Glu Glu Met Tyr Leu Thr Glu
1 5 10 15

Arg Leu Asp Val Gln Ile Ala His Phe Leu Lys Lys Ser Val Gln His
20 25 30

Arg Arg Arg Tyr Lys Val Leu Lys Ile Thr Glu Ile Val Ala Gly Phe
35 40 45

Leu Ile Ala Val Phe Cys Ala Ile Pro Met Pro Gly Asp Arg Tyr Arg
50 55 60

Leu Ile Ser Val Ala Leu Ser Ser Leu Gly Leu Leu Cys Glu Gly Ile
65 70 75 80

Ile Asn Leu Tyr Asn Ala Lys Glu Asn Trp Ile Ser Tyr Gln Lys Thr
85 90 95

Ala Gln Leu Leu Glu Lys Glu Lys Phe Leu Tyr Gln Cys Gln Thr Glu
100 105 110

Lys Tyr Ala Gly Lys Thr Lys Ala Phe Ala Leu Phe Val Lys Thr Cys
115 120 125

Glu Gly Leu Ile Ser Glu Glu Ile Asn Gln Trp Glu Ser Ile Gln Ser
130 135 140

Lys Glu Val Ala Ala Ser Ala Asp Ala Pro Val Lys Lys Glu
145 150 155

<210> 720
<211> 388
<212> PRT
<213> Streptococcus pneumoniae

<400> 720

Met Ala Lys Lys Pro Lys Lys Leu Glu Glu Ile Ser Lys Lys Phe Gly
1 5 10 15

Ala Glu Arg Glu Lys Ala Leu Asn Asp Ala Leu Lys Leu Ile Glu Lys
20 25 30

Asp Phe Gly Lys Gly Ser Ile Met Arg Leu Gly Glu Arg Ala Glu Gln
35 40 45

Lys Val Gln Val Met Ser Ser Gly Ser Leu Ala Leu Asp Ile Ala Leu
50 55 60

Gly Ser Gly Gly Tyr Pro Lys Gly Arg Ile Ile Glu Ile Tyr Gly Pro
65 70 75 80

Glu Ser Ser Gly Lys Thr Thr Val Ala Leu His Ala Val Ala Gln Ala
85 90 95

Gln Lys Glu Gly Gly Ile Ala Ala Phe Ile Asp Ala Glu His Ala Leu
100 105 110

Asp Pro Ala Tyr Ala Ala Ala Leu Gly Val Asn Ile Asp Glu Leu Leu
115 120 125

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Leu Ser Gln Pro Asp Ser Gly Glu Gln Gly Leu Glu Ile Ala Gly Lys
    130                 135                 140

Leu Ile Asp Ser Gly Ala Val Asp Leu Val Val Val Asp Ser Val Ala
145                 150                 155                 160

Ala Leu Val Pro Arg Ala Glu Ile Asp Gly Asp Ile Gly Asp Ser His
                165                 170                 175

Val Gly Leu Gln Ala Arg Met Met Ser Gln Ala Met Arg Lys Leu Gly
            180                 185                 190

Ala Ser Ile Asn Lys Thr Lys Thr Ile Ala Ile Phe Ile Asn Gln Leu
        195                 200                 205

Arg Glu Lys Val Gly Val Met Phe Gly Asn Pro Glu Thr Thr Pro Gly
    210                 215                 220

Gly Arg Ala Leu Lys Phe Tyr Ala Ser Val Arg Leu Asp Val Arg Gly
225                 230                 235                 240

Asn Thr Gln Ile Lys Gly Thr Gly Asp Gln Lys Glu Thr Asn Val Gly
                245                 250                 255

Lys Glu Thr Lys Ile Lys Val Val Lys Asn Lys Val Ala Pro Pro Phe
            260                 265                 270

Lys Glu Ala Val Val Glu Ile Met Tyr Gly Glu Gly Ile Ser Lys Thr
        275                 280                 285

Gly Glu Leu Leu Lys Ile Ala Ser Asp Leu Asp Ile Ile Lys Lys Ala
    290                 295                 300

Gly Ala Trp Tyr Ser Tyr Lys Asp Glu Lys Ile Gly Gln Gly Ser Glu
305                 310                 315                 320

Asn Ala Lys Lys Tyr Leu Ala Glu His Pro Glu Ile Phe Asp Glu Ile
                325                 330                 335

Asp Lys Gln Val Arg Ser Lys Phe Gly Leu Ile Asp Gly Glu Glu Val
            340                 345                 350
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Ser Glu Gln Asp Thr Glu Asn Lys Lys Asp Glu Pro Lys Lys Glu Glu
355 360 365

Ala Val Asn Glu Glu Val Pro Leu Asp Leu Gly Asp Glu Leu Glu Ile
370 375 380

Glu Ile Glu Glu
385

<210> 721
<211> 1225
<212> PRT
<213> Streptococcus pneumoniae

<400> 721

Met Val Asp Val Asn Arg Phe Lys Ser Met Gln Ile Thr Leu Ala Ser
1 5 10 15

Pro Ser Lys Val Arg Ser Trp Ser Tyr Gly Glu Val Lys Lys Pro Glu
20 25 30

Thr Ile Asn Tyr Arg Thr Leu Lys Pro Glu Arg Glu Gly Leu Phe Asp
35 40 45

Glu Val Ile Phe Gly Pro Thr Lys Asp Trp Glu Cys Ala Cys Gly Lys
50 55 60

Tyr Lys Arg Ile Arg Tyr Arg Gly Ile Val Cys Asp Arg Cys Gly Val
65 70 75 80

Glu Val Thr Arg Thr Lys Val Arg Arg Glu Arg Met Gly His Ile Glu
85 90 95

Leu Lys Ala Pro Val Ser His Ile Trp Tyr Phe Lys Gly Ile Pro Ser
100 105 110

Arg Met Gly Leu Thr Leu Asp Met Ser Pro Arg Ala Leu Glu Glu Val
115 120 125

Ile Tyr Phe Ala Ala Tyr Val Val Ile Asp Pro Lys Asp Thr Pro Leu
130 135 140

Glu His Lys Ser Ile Met Thr Glu Arg Glu Tyr Arg Glu Arg Leu Arg
145 150 155 160

Glu Tyr Gly Tyr Gly Ser Phe Val Ala Lys Met Gly Ala Glu Ala Ile
165 170 175

Gln Asp Leu Leu Lys Gln Val Asp Leu Glu Lys Glu Ile Ala Glu Leu
180 185 190

Lys Glu Glu Leu Lys Thr Ala Thr Gly Gln Lys Arg Val Lys Ala Ile
195 200 205

Arg Arg Leu Asp Val Leu Asp Ala Phe Tyr Lys Ser Gly Asn Lys Pro
210 215 220

Glu Trp Met Ile Leu Asn Ile Leu Pro Val Ile Pro Pro Asp Leu Arg
225 230 235 240

Pro Met Leu Gln Leu Asp Gly Gly Arg Phe Ala Ser Ser Asp Leu Asn
245 250 255

Asp Leu Tyr Arg Arg Val Ile Asn Arg Asn Asn Arg Leu Ala Arg Leu
260 265 270

Leu Glu Leu Asn Ala Pro Gly Ile Ile Val Gln Asn Glu Lys Arg Met
275 280 285

Leu Gln Glu Ala Val Asp Ala Leu Ile Asp Asn Gly Arg Arg Gly Arg
290 295 300

Pro Ile Thr Gly Pro Gly Ser Arg Pro Leu Lys Ser Leu Ser His Met
305 310 315 320

Leu Lys Gly Lys Gln Gly Arg Phe Arg Gln Asn Leu Leu Gly Lys Arg
325 330 335

Val Asp Phe Ser Gly Arg Ser Val Ile Ala Val Gly Pro Thr Leu Lys
340 345 350

Met Tyr Gln Cys Gly Val Pro Arg Glu Met Ala Ile Glu Leu Phe Lys

355 360 365

Pro Phe Val Met Arg Glu Ile Val Ala Arg Asp Ile Val Gln Asn Val
370 375 380

Lys Ala Ala Lys Arg Leu Val Glu Arg Gly Asp Glu Arg Ile Trp Asp
385 390 395 400

Ile Leu Glu Glu Val Ile Lys Glu His Pro Val Leu Leu Asn Arg Ala
405 410 415

Pro Thr Leu His Arg Leu Gly Ile Gln Ala Phe Glu Pro Val Leu Ile
420 425 430

Asp Gly Lys Ala Leu Arg Leu His Pro Leu Val Cys Glu Ala Tyr Asn
435 440 445

Ala Asp Phe Asp Gly Asp Gln Met Ala Ile His Val Pro Leu Ser Glu
450 455 460

Glu Ala Gln Ala Glu Ala Arg Ile Leu Met Leu Ala Ala Glu His Ile
465 470 475 480

Leu Asn Pro Lys Asp Gly Lys Pro Val Val Thr Pro Ser Gln Asp Met
485 490 495

Val Leu Gly Asn Tyr Tyr Leu Thr Met Glu Glu Ala Gly Arg Glu Gly
500 505 510

Glu Gly Met Val Phe Lys Asp Arg Asp Glu Ala Val Met Ala Tyr Arg
515 520 525

Asn Gly Tyr Val His Leu His Ser Arg Val Gly Ile Ala Thr Asp Ser
530 535 540

Leu Asn Lys Pro Trp Thr Glu Glu Gln Arg His Lys Val Leu Leu Thr
545 550 555 560

Thr Val Gly Lys Ile Leu Phe Asn Asp Ile Met Pro Glu Gly Leu Pro
565 570 575

Tyr Leu Gln Glu Pro Asn Asn Ala Asn Leu Thr Glu Gly Val Pro Ala
580 585 590

Lys Tyr Phe Leu Pro Leu Gly Gly Asp Ile Lys Glu Ala Ile Ser Asn
595 600 605

Leu Glu Leu Asn Pro Pro Phe Lys Lys Lys Asn Leu Gly Asn Ile Ile
610 615 620

Ala Glu Ile Phe Lys Arg Phe Arg Thr Thr Glu Thr Ser Ala Leu Leu
625 630 635 640

Asp Arg Met Lys Asn Leu Gly Tyr His His Ser Thr Leu Ala Gly Leu
645 650 655

Thr Val Gly Ile Ala Asp Ile Pro Val Val Asp Asp Lys Ala Glu Ile
660 665 670

Ile Glu Glu Ser His Lys Arg Val Glu Gln Ile Thr Lys Gln Phe Arg
675 680 685

Arg Gly Met Ile Thr Asp Asp Glu Arg Tyr Asn Ala Val Thr Ala Glu
690 695 700

Trp Arg Ala Ala Arg Glu Lys Leu Glu Lys Arg Leu Ile Ala Asn Gln
705 710 715 720

Asp Pro Lys Asn Pro Ile Val Met Met Met Asp Ser Gly Ala Arg Gly
725 730 735

Asn Ile Ser Asn Phe Ser Gln Leu Ala Gly Met Arg Gly Leu Met Ala
740 745 750

Ala Pro Asn Gly Arg Ile Met Glu Leu Pro Ile Leu Ser Asn Phe Arg
755 760 765

Glu Gly Leu Ser Val Leu Glu Met Phe Phe Ser Thr His Gly Ala Arg
770 775 780

Lys Gly Met Thr Asp Thr Ala Leu Lys Thr Ala Asp Ser Gly Tyr Leu
785 790 795 800

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Thr Arg Arg Leu Val Asp Val Ala Gln Asp Val Ile Ile Arg Glu Asp
                805                 810                 815

Asp Cys Gly Thr Asp Arg Gly Leu Leu Ile Arg Ser Ile Ala Glu Gly
            820                 825                 830

Lys Glu Met Ile Glu Ser Leu Glu Glu Arg Leu Asn Gly Arg Tyr Thr
        835                 840                 845

Lys Lys Thr Val Lys His Pro Glu Thr Gly Ala Val Ile Ile Gly Pro
    850                 855                 860

Asn Glu Leu Ile Thr Glu Asp Lys Ala Arg Glu Ile Val Asn Ala Gly
865                 870                 875                 880

Val Glu Glu Val Thr Ile Arg Ser Val Phe Thr Cys Asn Thr Arg His
                885                 890                 895

Gly Val Cys Arg His Cys Tyr Gly Ile Asn Leu Ala Thr Gly Asp Ala
            900                 905                 910

Val Glu Val Gly Glu Ala Val Gly Thr Ile Ala Ala Gln Ser Ile Gly
        915                 920                 925

Glu Pro Gly Thr Gln Leu Thr Met Arg Thr Phe His Thr Gly Gly Val
    930                 935                 940

Ala Ser Asn Thr Asp Ile Thr Gln Gly Leu Pro Arg Val Gln Glu Ile
945                 950                 955                 960

Phe Glu Ala Arg Asn Pro Lys Gly Glu Ala Val Ile Thr Glu Val Lys
                965                 970                 975

Gly Gln Val Thr Ala Ile Glu Glu Asp Ala Ser Thr Arg Thr Lys Lys
            980                 985                 990

Val Phe Val Lys Gly Glu Thr Gly  Glu Gly Glu Tyr Val  Val Pro Phe
        995                 1000                 1005

Thr Ala  Arg Met Arg Val Glu  Val Gly Gly Gln Val  Ala Arg Gly
    1010                 1015                 1020
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Ala Ala Leu Thr Glu Gly Ser Ile Gln Pro Lys Arg Leu Leu Ala
1025 1030 1035

Val Arg Asp Val Leu Ser Val Glu Thr Tyr Leu Leu Gly Glu Val
1040 1045 1050

Gln Lys Val Tyr Arg Ser Gln Gly Val Glu Ile Gly Asp Lys His
1055 1060 1065

Ile Glu Val Met Val Arg Gln Met Ile Arg Lys Val Arg Val Met
1070 1075 1080

Asp Pro Gly Asp Thr Asp Leu Leu Met Gly Thr Leu Met Asp Ile
1085 1090 1095

Asn Asp Phe Thr Asp Ala Asn Lys Asp Val Leu Ile Ala Gly Gly
1100 1105 1110

Val Pro Ala Thr Gly Arg Pro Val Leu Met Gly Ile Thr Lys Ala
1115 1120 1125

Ser Leu Glu Thr Asn Ser Phe Leu Ser Ala Ala Ser Phe Gln Glu
1130 1135 1140

Thr Thr Arg Val Leu Thr Asp Ala Ala Ile Arg Gly Lys Lys Asp
1145 1150 1155

His Leu Leu Gly Leu Lys Glu Asn Val Ile Ile Gly Lys Ile Ile
1160 1165 1170

Pro Ala Gly Thr Gly Met Ala Arg Tyr Arg Asn Leu Glu Pro His
1175 1180 1185

Ala Val Asn Glu Glu Glu Tyr Leu Asn Pro Pro Val Glu Glu Glu
1190 1195 1200

Gly Asn Glu Glu Thr Thr Glu Val Val Val Asp Thr Ala Val Glu
1205 1210 1215

Thr Val Glu Glu Thr Val Glu

1220 1225

<210> 722
<211> 332
<212> PRT
<213> Streptococcus pneumoniae

<400> 722

Met Ser Met Lys Lys Ser Phe Ile His Gln Gln Glu Glu Ile Ser Phe
1 5 10 15

Val Lys Asn Thr Phe Thr Gln Tyr Leu Lys Asp Lys Leu Glu Val Val
20 25 30

Glu Val Gln Gly Pro Ile Leu Ser Lys Val Gly Asp Gly Met Gln Asp
35 40 45

Asn Leu Ser Gly Val Glu Asn Pro Val Ser Val Lys Val Leu Gln Ile
50 55 60

Pro Asp Ala Thr Tyr Glu Val Val His Ser Leu Ala Lys Trp Lys Arg
65 70 75 80

His Thr Leu Ala Arg Phe Gly Phe Gly Glu Gly Glu Gly Leu Phe Val
85 90 95

His Met Lys Ala Leu Arg Pro Asp Glu Asp Ser Leu Asp Ala Thr His
100 105 110

Ser Val Tyr Val Asp Gln Trp Asp Trp Glu Lys Val Ile Pro Asn Gly
115 120 125

Lys Arg Asn Ile Val Tyr Leu Lys Glu Thr Val Glu Lys Ile Tyr Lys
130 135 140

Ala Ile Arg Leu Thr Glu Leu Ala Val Glu Ala Arg Tyr Asp Ile Glu
145 150 155 160

Ser Ile Leu Pro Lys Gln Ile Thr Phe Ile His Thr Glu Glu Leu Val
165 170 175

Glu Arg Tyr Pro Asp Leu Thr Pro Lys Glu Arg Glu Asn Ala Ile Cys

180 185 190

Lys Glu Phe Gly Ala Val Phe Leu Ile Gly Ile Gly Gly Glu Leu Pro
195 200 205

Asp Gly Lys Pro His Asp Gly Arg Ala Pro Asp Tyr Asp Asp Trp Thr
210 215 220

Ser Glu Ser Glu Asn Gly Tyr Lys Gly Leu Asn Gly Asp Ile Leu Val
225 230 235 240

Trp Asn Glu Ser Leu Gly Gly Ala Phe Glu Leu Ser Ser Met Gly Ile
245 250 255

Arg Val Asp Glu Glu Thr Leu Arg Arg Gln Val Glu Ile Thr Gly Asp
260 265 270

Glu Asp Arg Leu Glu Leu Glu Trp His Lys Ser Leu Leu Asn Gly Leu
275 280 285

Phe Pro Leu Thr Ile Gly Gly Gly Ile Gly Gln Ser Arg Met Ala Met
290 295 300

Phe Leu Leu Arg Lys Arg His Ile Gly Glu Val Gln Thr Ser Val Trp
305 310 315 320

Pro Gln Glu Val Arg Asp Thr Tyr Glu Asn Ile Leu
325 330

<210> 723
<211> 275
<212> PRT
<213> Streptococcus pneumoniae

<400> 723

Met Lys Leu Arg Arg Ser Asp Arg Met Val Val Ile Ser Asn Tyr Leu
1 5 10 15

Ile Asn Asn Pro Tyr Lys Leu Thr Ser Leu Asn Thr Phe Ala Glu Lys
20 25 30

Tyr Glu Ser Ala Lys Ser Ser Ile Ser Glu Asp Ile Val Ile Ile Lys

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        35                  40                  45

Arg Ala Phe Glu Glu Ile Glu Ile Gly His Ile Gln Thr Val Thr Gly
    50                  55                  60

Ala Gly Gly Gly Val Ile Phe Thr Pro Ser Ile Ser Ser Gln Asp Ala
65                  70                  75                  80

Lys Glu Met Val Glu Asp Leu Arg Thr Lys Leu Ser Glu Ser Asp Arg
                85                  90                  95

Ile Leu Pro Gly Gly Tyr Ile Tyr Leu Ser Asp Leu Leu Ser Thr Pro
            100                 105                 110

Ala Ile Leu Lys Asn Ile Gly Arg Ile Ile Ala Lys Ser Phe Met Asp
        115                 120                 125

Gln Lys Ile Asp Ala Val Met Thr Val Ala Thr Lys Gly Val Pro Leu
    130                 135                 140

Ala Asn Ala Val Ala Asn Val Leu Asn Val Ser Phe Val Ile Val Arg
145                 150                 155                 160

Arg Asp Leu Lys Ile Thr Glu Gly Ser Thr Val Ser Val Asn Tyr Val
                165                 170                 175

Ser Gly Ser Ser Gly Asp Arg Ile Glu Lys Met Phe Leu Ser Lys Arg
            180                 185                 190

Ser Leu Lys Ala Gly Ser Arg Val Leu Ile Val Asp Asp Phe Leu Lys
        195                 200                 205

Gly Gly Gly Thr Val Asn Gly Met Ile Ser Leu Leu Arg Glu Phe Asp
    210                 215                 220

Ser Glu Leu Ala Gly Val Ala Val Phe Ala Asp Asn Ala Gln Glu Glu
225                 230                 235                 240

Arg Glu Lys Gln Phe Asp Tyr Lys Ser Leu Leu Lys Val Thr Asn Ile
                245                 250                 255
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Asp Val Lys Asn Gln Ala Ile Asp Val Glu Val Gly Asn Ile Phe Asp
260 265 270

Glu Asp Lys
275

<210> 724
<211> 404
<212> PRT
<213> Streptococcus pneumoniae

<400> 724

Met Lys Glu Tyr Asn Lys Ser Ser Lys Leu Glu His Val Ala Tyr Asp
1 5 10 15

Ile Arg Gly Pro Val Leu Glu Glu Ala Met Arg Met Arg Ala Asn Gly
20 25 30

Glu Lys Ile Leu Arg Leu Asn Thr Gly Asn Pro Ala Glu Phe Gly Phe
35 40 45

Thr Ala Pro Asp Glu Val Ile His Asp Leu Ile Met Asn Ala Arg Asp
50 55 60

Ser Glu Gly Tyr Ser Asp Ser Lys Gly Ile Phe Ser Ala Arg Lys Ala
65 70 75 80

Ile Met Gln Tyr Cys Gln Leu Lys Lys Phe Pro Asn Val Asp Thr Asp
85 90 95

Asp Ile Tyr Leu Gly Asn Gly Val Ser Glu Leu Ile Val Met Ser Met
100 105 110

Gln Gly Leu Leu Asp Asn Gly Asp Glu Val Leu Val Pro Met Pro Asp
115 120 125

Tyr Pro Leu Trp Thr Ala Ala Val Ser Leu Ala Gly Gly Asn Ala Val
130 135 140

His Tyr Ile Cys Asp Glu Ala Val Glu Trp Tyr Pro Asp Ile Asp Asp
145 150 155 160

Ile Lys Ser Lys Ile Thr Ser Asn Thr Lys Ala Ile Val Leu Ile Asn
165 170 175

Pro Asn Asn Pro Thr Gly Ala Leu Tyr Pro Lys Glu Leu Leu Leu Glu
180 185 190

Ile Ile Glu Ile Ala Arg Gln Asn Asp Leu Ile Ile Phe Ala Asp Glu
195 200 205

Ile Tyr Asp Arg Met Val Met Asp Gly His Val His Thr Pro Val Ala
210 215 220

Ser Leu Ala Pro Asp Val Phe Cys Val Ser Met Asn Gly Leu Ser Lys
225 230 235 240

Ser His Arg Ile Ala Gly Phe Arg Val Gly Trp Met Val Leu Ser Gly
245 250 255

Pro Lys Thr His Val Lys Gly Tyr Ile Glu Gly Leu Asn Met Leu Ser
260 265 270

Asn Met Arg Leu Cys Ser Asn Val Leu Ala Gln Gln Val Val Gln Thr
275 280 285

Ser Leu Gly Gly His Gln Ser Val Asp Glu Leu Leu Leu Pro Gly Gly
290 295 300

Arg Ile Tyr Glu Gln Arg Asn Phe Ile Tyr Asn Ala Ile Gln Asp Ile
305 310 315 320

Pro Gly Leu Ser Ala Val Lys Pro Lys Ala Gly Leu Tyr Ile Phe Pro
325 330 335

Lys Ile Asp Arg Asn Met Tyr Arg Ile Asp Asp Asp Glu Gln Phe Val
340 345 350

Leu Asp Phe Leu Lys Gln Glu Lys Val Leu Leu Val His Gly Arg Gly
355 360 365

Phe Asn Trp Gln Glu Pro Asp His Phe Arg Ile Val Tyr Leu Pro Arg
370 375 380

Val Asp Glu Leu Ala Gln Ile Gln Glu Lys Met Thr Arg Phe Leu Lys
385 390 395 400

Gln Tyr Arg Arg

<210> 725
<211> 171
<212> PRT
<213> Streptococcus pneumoniae

<400> 725

Met Leu Tyr Phe Tyr Ser Glu Lys Val Tyr Asn Tyr Ser Lys Lys Ile
1 5 10 15

Ser Gly Gly Phe Ile Met Ala Gln Arg Tyr Gln Asn Ile Met Val Ala
20 25 30

Ile Asp Gly Ser Lys Glu Ala Asp Leu Ala Phe Val Lys Gly Val His
35 40 45

Ser Ala Leu Arg Asn Asp Ala Lys Leu Thr Ile Ala His Val Ile Asp
50 55 60

Thr Arg Ala Leu Gln Ser Val Ser Thr Phe Asp Ala Glu Val Tyr Glu
65 70 75 80

Glu Leu Gln Val Asp Ala Glu Ser Leu Met Lys Glu Tyr Glu Lys Arg
85 90 95

Ala Lys Asp Ala Gly Val Ala Asp Val His Ile Val Ile Glu Met Gly
100 105 110

Asn Pro Lys Thr Leu Leu Ala Arg Thr Ile Pro Asp Ala Glu Glu Val
115 120 125

Asp Leu Ile Leu Val Gly Ala Thr Gly Leu Asn Ala Phe Glu Arg Leu
130 135 140

Leu Val Gly Ser Ser Ser Glu Tyr Ile Leu Arg His Ala Lys Val Asp
145 150 155 160

Leu Leu Val Val Arg Glu Gln Glu Lys Thr Leu
165 170

<210> 726
<211> 346
<212> PRT
<213> Streptococcus pneumoniae

<400> 726

Met Cys Glu Ile Glu Arg Thr Gly Lys Gly Met Asn Ala Asp Asp Thr
1 5 10 15

Val Thr Ile Tyr Asp Val Ala Arg Glu Ala Gly Val Ser Met Ala Thr
20 25 30

Val Ser Arg Val Val Asn Gly Asn Lys Asn Val Lys Glu Asn Thr Arg
35 40 45

Lys Lys Val Leu Glu Val Ile Asp Arg Leu Asp Tyr Arg Pro Asn Ala
50 55 60

Val Ala Arg Gly Leu Ala Ser Lys Lys Thr Thr Thr Val Gly Val Val
65 70 75 80

Ile Pro Asn Ile Thr Asn Gly Tyr Phe Ser Ser Leu Ala Lys Gly Ile
85 90 95

Asp Asp Ile Ala Glu Met Tyr Lys Tyr Asn Ile Val Leu Ala Asn Ser
100 105 110

Asp Glu Asp Asn Glu Lys Glu Val Ser Val Val Asn Thr Leu Phe Ser
115 120 125

Lys Gln Val Asp Gly Ile Ile Tyr Met Gly Tyr His Leu Thr Asp Lys
130 135 140

Ile Arg Ser Glu Phe Ser Arg Ser Arg Thr Pro Ile Val Leu Ala Gly
145 150 155 160

Thr Val Asp Val Glu His Gln Leu Pro Ser Val Asn Ile Asp Tyr Lys
165 170 175

Gln Ala Thr Ile Asp Ala Val Ser Tyr Leu Ala Lys Glu Asn Glu Arg
180 185 190

Ile Ala Phe Val Ser Gly Pro Leu Val Asp Asp Ile Asn Gly Lys Val
195 200 205

Arg Leu Val Gly Tyr Lys Glu Thr Leu Lys Lys Ala Gly Ile Thr Tyr
210 215 220

Ser Glu Gly Leu Val Phe Glu Ser Lys Tyr Ser Tyr Asp Asp Gly Tyr
225 230 235 240

Ala Leu Ala Glu Arg Leu Ile Ser Ser Asn Ala Thr Ala Ala Val Val
245 250 255

Thr Gly Asp Glu Leu Ala Ala Gly Val Leu Asn Gly Leu Ala Asp Lys
260 265 270

Gly Val Ser Val Pro Glu Asp Phe Glu Ile Ile Thr Ser Asp Asp Ser
275 280 285

Gln Ile Ser Arg Phe Thr Arg Pro Asn Leu Thr Thr Ile Ala Gln Pro
290 295 300

Leu Tyr Asp Leu Gly Ala Ile Ser Met Arg Met Leu Thr Lys Ile Met
305 310 315 320

His Lys Glu Glu Leu Glu Glu Arg Glu Val Leu Leu Pro His Gly Leu
325 330 335

Thr Glu Arg Ser Ser Thr Arg Lys Arg Lys
340 345

<210> 727
<211> 183
<212> PRT
<213> Streptococcus pneumoniae

<400> 727

Met Lys Gly Asn Ile Met Asp Ser Phe Asp Lys Gly Trp Phe Val Leu
1 5 10 15

Gln Thr Tyr Ser Gly Tyr Glu Asn Lys Val Lys Glu Asn Leu Leu Gln
20 25 30

Arg Ala Gln Thr Tyr Asn Met Leu Asp Asn Ile Leu Arg Val Glu Ile
35 40 45

Pro Thr Gln Thr Val Gln Val Glu Lys Asn Gly Lys Arg Lys Glu Val
50 55 60

Glu Glu Asn Arg Phe Pro Gly Tyr Val Leu Val Glu Met Val Met Thr
65 70 75 80

Asp Glu Ala Trp Phe Val Val Arg Asn Thr Pro Asn Val Thr Gly Phe
85 90 95

Val Gly Ser His Gly Asn Arg Ser Lys Pro Thr Pro Leu Leu Glu Gln
100 105 110

Glu Ile Arg Asp Ile Leu Val Ser Met Gly Gln Thr Val Gln Glu Phe
115 120 125

Asp Phe Asp Val Glu Ile Gly Gln Thr Val Arg Ile Ile Asp Gly Ala
130 135 140

Phe Ala Asp Tyr Thr Gly Lys Ile Thr Glu Ile Asp Asn Asn Lys Val
145 150 155 160

Lys Met Ile Ile Ser Met Phe Gly Asn Asp Thr Val Ala Glu Val Asn
165 170 175

Leu Asn Gln Ile Ala Glu Leu
180

<210> 728
<211> 731
<212> PRT
<213> Streptococcus pneumoniae

<400> 728

Met Lys Leu Asp Lys Leu Phe Glu Lys Phe Leu Ser Leu Phe Lys Lys
1 5 10 15

Glu Thr Ser Glu Leu Glu Asp Ser Asp Ser Thr Ile Leu Arg Arg Ser
20 25 30

Arg Ser Asp Arg Lys Lys Leu Ala Gln Val Gly Pro Ile Arg Lys Phe
35 40 45

Trp Arg Arg Tyr His Leu Thr Lys Ile Ile Leu Ile Leu Gly Leu Ser
50 55 60

Ala Gly Leu Leu Val Gly Ile Tyr Leu Phe Ala Val Ala Lys Ser Thr
65 70 75 80

Asn Val Asn Asp Leu Gln Asn Ala Leu Lys Thr Arg Thr Leu Ile Phe
85 90 95

Asp Arg Glu Glu Lys Glu Ala Gly Ala Leu Ser Gly Gln Lys Gly Thr
100 105 110

Tyr Val Glu Leu Thr Asp Ile Ser Lys Asn Leu Gln Asn Ala Val Ile
115 120 125

Ala Thr Glu Asp Arg Ser Phe Tyr Lys Asn Asp Gly Ile Asn Tyr Gly
130 135 140

Arg Phe Phe Leu Ala Ile Val Thr Ala Gly Arg Ser Gly Gly Gly Ser
145 150 155 160

Thr Ile Thr Gln Gln Leu Ala Lys Asn Ala Tyr Leu Ser Gln Asp Gln
165 170 175

Thr Val Glu Arg Lys Ala Lys Glu Phe Phe Leu Ala Leu Glu Leu Ser
180 185 190

Lys Lys Tyr Ser Lys Glu Gln Ile Leu Thr Met Tyr Leu Asn Asn Ala
195 200 205

Tyr Phe Gly Asn Gly Val Trp Gly Val Glu Asp Ala Ser Lys Lys Tyr
210 215 220

Phe Gly Val Ser Ala Ser Glu Val Ser Leu Asp Gln Ala Ala Thr Leu
225 230 235 240

Ala Gly Met Leu Lys Gly Pro Glu Leu Tyr Asn Pro Leu Asn Ser Val
245 250 255

Glu Asp Ser Thr Asn Arg Arg Asp Thr Val Leu Gln Asn Met Val Ala
260 265 270

Ala Gly Tyr Ile Asp Lys Asn Gln Glu Thr Lys Ala Ala Glu Val Asp
275 280 285

Met Thr Ser Gln Leu His Asp Lys Tyr Glu Gly Lys Ile Ser Asp Tyr
290 295 300

Arg Tyr Pro Ser Tyr Phe Asp Ala Val Val Asn Glu Ala Val Ser Lys
305 310 315 320

Tyr Asn Leu Thr Glu Glu Glu Ile Val Asn Asn Gly Tyr Arg Ile Tyr
325 330 335

Thr Glu Leu Asp Gln Asn Tyr Gln Ala Asn Met Gln Ile Val Tyr Glu
340 345 350

Asn Thr Ser Leu Phe Pro Arg Ala Glu Asp Gly Thr Phe Ala Gln Ser
355 360 365

Gly Ser Val Ala Leu Glu Pro Lys Thr Gly Gly Val Arg Gly Val Val
370 375 380

Gly Gln Val Ala Asp Asn Asp Lys Thr Gly Phe Arg Asn Phe Asn Tyr
385 390 395 400

Ala Thr Gln Ser Lys Arg Ser Pro Gly Ser Thr Ile Lys Pro Leu Val
405 410 415

Val Tyr Thr Pro Ala Val Glu Ala Ser Trp Ala Leu Asn Lys Gln Leu
420 425 430

Asp Asn His Thr Met Gln Tyr Asp Ser Tyr Lys Val Asp Asn Tyr Ala
435 440 445

Gly Ile Lys Thr Ser Arg Glu Val Pro Met Tyr Gln Ala Leu Ala Glu

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    450                 455                 460

Ser Leu Asn Leu Pro Ala Val Ala Thr Val Asn Asp Leu Gly Val Asp
465                 470                 475                 480

Lys Ala Phe Glu Ala Gly Glu Lys Phe Gly Leu Asn Met Glu Lys Val
                485                 490                 495

Asp Arg Val Leu Gly Val Ala Leu Gly Ser Gly Val Glu Thr Asn Pro
            500                 505                 510

Leu Gln Met Ala Gln Ala Tyr Ala Ala Phe Ala Asn Glu Gly Leu Met
        515                 520                 525

Pro Glu Ala His Phe Ile Ser Arg Ile Glu Asn Ala Ser Gly Gln Val
    530                 535                 540

Ile Ala Ser His Lys Asn Ser Gln Lys Arg Val Ile Asp Lys Ser Val
545                 550                 555                 560

Ala Asp Lys Met Thr Ser Met Met Leu Gly Thr Phe Thr Asn Gly Thr
                565                 570                 575

Gly Ile Ser Ser Ser Pro Ala Asp Tyr Val Met Ala Gly Lys Thr Gly
            580                 585                 590

Thr Thr Glu Ala Val Phe Asn Pro Glu Tyr Thr Ser Asp Gln Trp Val
        595                 600                 605

Ile Gly Tyr Thr Pro Asp Val Val Ile Ser His Trp Leu Gly Phe Pro
    610                 615                 620

Thr Thr Asp Glu Asn His Tyr Leu Ala Gly Ser Thr Ser Asn Gly Ala
625                 630                 635                 640

Ala His Val Phe Arg Asn Ile Ala Asn Thr Ile Leu Pro Tyr Thr Pro
                645                 650                 655

Gly Ser Thr Phe Thr Val Glu Asn Ala Tyr Lys Gln Asn Gly Ile Ala
            660                 665                 670
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Pro Ala Asn Thr Lys Arg Gln Val Gln Thr Asn Asp Asn Ser Gln Thr
        675   680   685

Asp Asp Asn Leu Ser Asp Ile Arg Gly Arg Ala Gln Ser Leu Val Asp
    690   695   700

Glu Ala Ser Arg Ala Ile Ser Asp Ala Lys Ile Lys Glu Lys Ala Gln
705   710   715   720

Thr Ile Trp Asp Ser Ile Val Asn Leu Phe Arg
                725   730

<210> 729
<211> 396
<212> PRT
<213> Streptococcus pneumoniae

<400> 729

Met Thr Lys Thr Ile Ala Ile Asn Ala Gly Ser Ser Ser Leu Lys Trp
1   5   10   15

Gln Leu Tyr Leu Met Pro Glu Glu Lys Val Leu Ala Lys Gly Leu Ile
            20   25   30

Glu Arg Ile Gly Leu Lys Asp Ser Ile Ser Thr Val Lys Phe Asp Gly
        35   40   45

Arg Ser Glu Gln Gln Ile Leu Asp Ile Glu Asn His Ile Gln Ala Val
    50   55   60

Lys Ile Leu Leu Asp Asp Leu Ile Arg Phe Asp Ile Ile Lys Ala Tyr
65   70   75   80

Asp Glu Ile Thr Gly Val Gly His Arg Val Val Ala Gly Gly Glu Tyr
                85   90   95

Phe Lys Glu Ser Thr Val Val Glu Gly Asp Val Leu Glu Lys Val Glu
            100   105   110

Glu Leu Ser Leu Leu Ala Pro Leu His Asn Pro Ala Asn Ala Ala Gly
        115   120   125

Val Arg Ala Phe Lys Glu Leu Leu Pro Asp Ile Thr Ser Val Val Val
130 135 140

Phe Asp Thr Ser Phe His Thr Ser Met Pro Glu Lys Ala Tyr Arg Tyr
145 150 155 160

Pro Leu Pro Thr Lys Tyr Tyr Thr Glu Asn Lys Val Arg Lys Tyr Gly
165 170 175

Ala His Gly Thr Ser His Gln Phe Val Ala Gly Glu Ala Ala Lys Leu
180 185 190

Leu Gly Arg Pro Leu Glu Asp Leu Lys Leu Ile Thr Cys His Ile Gly
195 200 205

Asn Gly Gly Ser Ile Thr Ala Val Lys Ala Gly Lys Ser Val Asp Thr
210 215 220

Ser Met Gly Phe Thr Pro Leu Gly Gly Ile Met Met Gly Thr Arg Thr
225 230 235 240

Gly Asp Ile Asp Pro Ala Ile Ile Pro Tyr Leu Met Gln Tyr Thr Glu
245 250 255

Asp Phe Asn Thr Pro Glu Asp Ile Ser Arg Val Leu Asn Arg Glu Ser
260 265 270

Gly Leu Leu Gly Val Ser Ala Asn Ser Ser Asp Met Arg Asp Ile Glu
275 280 285

Ala Ala Val Ala Glu Gly Asn His Glu Ala Ser Leu Ala Tyr Glu Met
290 295 300

Tyr Val Asp Arg Ile Gln Lys His Ile Gly Gln Tyr Leu Ala Val Leu
305 310 315 320

Asn Gly Ala Asp Ala Ile Val Phe Thr Ala Gly Val Gly Glu Asn Ala
325 330 335

Glu Ser Phe Arg Arg Asp Val Ile Ser Gly Ile Ser Trp Phe Gly Cys
340 345 350

Asp Val Asp Asp Glu Lys Asn Val Phe Gly Val Thr Gly Asp Ile Ser
        355   360   365

Thr Glu Ala Ala Lys Ile Arg Val Leu Val Ile Pro Thr Asp Glu Glu
    370   375   380

Leu Val Ile Ala Arg Asp Val Glu Arg Leu Lys Lys
385   390   395

<210> 730
<211> 352
<212> PRT
<213> Streptococcus pneumoniae

<400> 730

Met Lys Ala Tyr Thr Tyr Val Lys Pro Gly Leu Ala Ser Phe Val Asp
1   5   10   15

Val Asp Lys Pro Val Ile Arg Lys Pro Thr Asp Ala Ile Val Arg Ile
            20   25   30

Val Lys Thr Thr Ile Cys Gly Thr Asp Leu His Ile Ile Lys Gly Asp
        35   40   45

Val Pro Thr Cys Gln Ser Gly Thr Ile Leu Gly His Glu Gly Ile Gly
    50   55   60

Ile Val Glu Glu Val Gly Glu Gly Val Ser Asn Phe Lys Lys Gly Asp
65   70   75   80

Lys Val Leu Ile Ser Cys Val Cys Ala Cys Gly Lys Cys Tyr Tyr Cys
                85   90   95

Lys Lys Gly Ile Tyr Ala His Cys Glu Asp Glu Gly Gly Trp Ile Phe
            100   105   110

Gly His Leu Ile Asp Gly Met Gln Ala Glu Tyr Leu Arg Val Pro His
        115   120   125

Ala Asp Asn Thr Leu Tyr His Thr Pro Glu Asp Leu Ser Asp Glu Ala
    130   135   140

Leu Val Met Leu Ser Asp Ile Leu Pro Thr Gly Tyr Glu Ile Gly Val
145 150 155 160

Leu Lys Gly Lys Val Glu Pro Gly Cys Ser Val Ala Ile Ile Gly Ser
165 170 175

Gly Pro Val Gly Leu Ala Ala Leu Leu Thr Ala Gln Phe Tyr Ser Pro
180 185 190

Ala Lys Leu Ile Met Val Asp Leu Asp Asp Asn Arg Leu Glu Thr Ala
195 200 205

Leu Ser Phe Gly Ala Thr His Lys Val Asn Ser Ser Asp Pro Glu Lys
210 215 220

Ala Ile Lys Glu Ile Tyr Asp Leu Thr Asp Gly Arg Gly Val Asp Val
225 230 235 240

Ala Ile Glu Ala Val Gly Ile Pro Ala Thr Phe Asp Phe Cys Gln Lys
245 250 255

Ile Ile Gly Val Asp Gly Thr Val Ala Asn Cys Gly Val His Gly Lys
260 265 270

Pro Val Glu Phe Asp Leu Asp Lys Leu Trp Ile Arg Asn Ile Asn Val
275 280 285

Thr Thr Gly Leu Val Ser Thr Asn Thr Thr Pro Gln Leu Leu Lys Ala
290 295 300

Leu Glu Ser His Lys Ile Glu Pro Glu Lys Leu Val Thr His Tyr Phe
305 310 315 320

Lys Leu Ser Glu Ile Glu Lys Ala Tyr Glu Val Phe Ser Lys Ala Ala
325 330 335

Asp His His Ala Ile Lys Val Ile Ile Glu Asn Asp Ile Ser Glu Ala
340 345 350

<210> 731
<211> 564

<212> PRT
<213> Streptococcus pneumoniae

<400> 731

Met Leu Ile Gln Lys Ile Lys Thr Tyr Lys Trp Gln Ala Leu Ala Ser
1   5   10   15

Leu Leu Met Thr Gly Leu Met Val Ala Ser Ser Leu Leu Gln Pro Arg
            20   25   30

Tyr Leu Gln Glu Val Leu Gly Ala Leu Leu Thr Gly Lys Tyr Glu Ala
        35   40   45

Ile Tyr Ser Ile Gly Ala Trp Leu Ile Gly Val Ala Val Val Gly Leu
    50   55   60

Val Ala Gly Gly Leu Asn Val Val Leu Ala Ala Tyr Ile Ala Gln Gly
65   70   75   80

Val Ser Ser Asp Leu Arg Glu Asp Ala Phe Arg Lys Ile Gln Thr Phe
                85   90   95

Ser Tyr Ala Asp Ile Glu Gln Phe Asn Ala Gly Asn Leu Val Val Arg
            100   105   110

Met Thr Asn Asp Ile Asn Gln Ile Gln Asn Val Val Met Met Thr Phe
        115   120   125

Gln Ile Leu Phe Arg Leu Pro Leu Leu Phe Ile Gly Ser Phe Ile Leu
    130   135   140

Ala Val Gln Thr Leu Pro Ser Leu Trp Trp Val Ile Val Leu Met Val
145   150   155   160

Val Leu Ile Phe Gly Leu Thr Ala Val Met Met Gly Met Met Gly Pro
                165   170   175

Arg Phe Ala Lys Phe Gln Thr Leu Leu Glu Arg Ile Asn Ala Ile Ala
            180   185   190

Lys Glu Asn Leu Arg Gly Val Arg Val Val Lys Ser Phe Val Gln Glu
        195   200   205

Lys Glu Gln Phe Ala Lys Phe Thr Glu Val Ser Asp Glu Leu Leu Gly
    210   215   220

Gln Asn Leu Tyr Ile Gly Tyr Ala Phe Ser Val Val Glu Pro Phe Met
225   230   235   240

Met Leu Val Gly Tyr Gly Ala Val Phe Leu Ser Ile Trp Leu Val Ala
                245   250   255

Gly Met Val Gln Ser Asp Pro Ser Val Val Gly Ser Ile Ala Ser Phe
            260   265   270

Val Asn Tyr Leu Ser Gln Ile Ile Phe Thr Ile Val Met Val Gly Phe
        275   280   285

Leu Gly Asn Ser Val Ser Arg Ala Met Ile Ser Met Arg Arg Ile Arg
    290   295   300

Glu Ile Leu Asp Ala Glu Pro Ala Met Thr Phe Lys Asp Ile Pro Asp
305   310   315   320

Glu Glu Leu Val Gly Ser Leu Ser Phe Glu Asn Val Thr Phe Thr Tyr
                325   330   335

Pro Met Asp Lys Glu Pro Met Leu Lys Asp Val Ser Phe Thr Ile Glu
            340   345   350

Pro Gly Gln Met Val Gly Val Val Gly Ala Thr Gly Ala Gly Lys Ser
        355   360   365

Thr Leu Ala Gln Leu Ile Pro Arg Leu Phe Asp Pro Gln Asp Gly Ala
    370   375   380

Ile Lys Ile Gly Gly Lys Asp Ile Arg Glu Val Ser Glu Gly Thr Leu
385   390   395   400

Arg Lys Thr Val Ser Ile Val Leu Gln Arg Ala Ile Leu Phe Ser Gly
                405   410   415

Thr Ile Ala Asp Asn Leu Arg Gln Gly Lys Gly Asn Ala Thr Leu Phe

420 425 430

Glu Met Glu Arg Ala Ala Asn Ile Ala Gln Ala Ser Glu Phe Ile His
435 440 445

Arg Met Glu Lys Thr Phe Glu Ser Pro Val Glu Glu Arg Gly Thr Asn
450 455 460

Phe Ser Gly Gly Gln Lys Gln Arg Met Ser Ile Ala Arg Gly Ile Val
465 470 475 480

Ser Asn Pro Arg Ile Leu Ile Phe Asp Asp Ser Thr Ser Ala Leu Asp
485 490 495

Ala Lys Ser Glu Arg Leu Val Gln Glu Ala Leu Asn Lys Asp Leu Lys
500 505 510

Gly Thr Thr Thr Ile Ile Ile Ala Gln Lys Ile Ser Ser Val Val His
515 520 525

Ala Asp Lys Ile Leu Val Leu Asn Gln Gly Arg Leu Ile Gly Gln Gly
530 535 540

Thr His Ala Asp Leu Val Ala Asn Asn Ala Val Tyr Arg Glu Ile Tyr
545 550 555 560

Glu Thr Gln Lys

<210> 732
<211> 338
<212> PRT
<213> Streptococcus pneumoniae

<400> 732

Met Glu Lys Gln Thr Val Ala Val Leu Gly Pro Gly Ser Trp Gly Thr
1 5 10 15

Ala Leu Ser Gln Val Leu Asn Asp Asn Gly His Glu Val Arg Ile Trp
20 25 30

Gly Asn Leu Pro Glu Gln Ile Asn Glu Ile Asn Thr His His Thr Asn

```
        35                  40                  45

Lys His Tyr Phe Lys Asp Val Val Leu Asp Glu Asn Ile Ile Ala Tyr
    50                  55                  60

Thr Asp Leu Ala Glu Thr Leu Lys Asp Val Asp Ala Ile Leu Phe Val
65                  70                  75                  80

Val Pro Thr Lys Val Thr Arg Leu Val Ala Gln Gln Val Ala Gln Thr
                85                  90                  95

Leu Asp His Lys Val Ile Ile Met His Ala Ser Lys Gly Leu Glu Pro
            100                 105                 110

Asp Ser His Lys Arg Leu Ser Thr Ile Leu Glu Glu Glu Ile Pro Glu
        115                 120                 125

His Leu Arg Ser Asp Ile Val Val Val Ser Gly Pro Ser His Ala Glu
    130                 135                 140

Glu Thr Ile Val Arg Asp Leu Thr Leu Ile Thr Ala Ala Ser Lys Asp
145                 150                 155                 160

Leu Gln Thr Ala Gln Tyr Val Gln Lys Leu Phe Ser Asn His Tyr Phe
                165                 170                 175

Arg Leu Tyr Thr Asn Thr Asp Val Ile Gly Val Glu Thr Ala Gly Ala
            180                 185                 190

Leu Lys Asn Ile Ile Ala Val Gly Ala Gly Ala Leu His Gly Leu Gly
        195                 200                 205

Phe Gly Asp Asn Ala Lys Ala Ala Ile Ile Ala Arg Gly Leu Ala Glu
    210                 215                 220

Ile Thr Arg Leu Gly Val Ala Leu Gly Ala Ser Pro Leu Thr Tyr Ser
225                 230                 235                 240

Gly Leu Ser Gly Val Gly Asp Leu Ile Val Thr Gly Thr Ser Ile His
                245                 250                 255
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Ser Arg Asn Trp Arg Ala Gly Asp Ala Leu Gly Arg Gly Glu Ser Leu
260 265 270

Ala Asp Ile Glu Ala Asn Met Gly Met Val Ile Glu Gly Ile Ser Thr
275 280 285

Thr Arg Ala Ala Tyr Glu Leu Ala Gln Glu Leu Gly Val Tyr Met Pro
290 295 300

Ile Thr Gln Ala Ile Tyr Gln Val Ile Tyr His Gly Thr Asn Ile Lys
305 310 315 320

Asp Ala Ile Tyr Asp Ile Met Asn Asn Glu Phe Lys Ala Glu Asn Glu
325 330 335

Trp Ser

<210> 733
<211> 423
<212> PRT
<213> Streptococcus pneumoniae

<400> 733

Met Ser Ser Lys Phe Met Lys Ser Ala Ala Val Leu Gly Thr Ala Thr
1 5 10 15

Leu Ala Ser Leu Leu Leu Val Ala Cys Gly Ser Lys Thr Ala Asp Lys
20 25 30

Pro Ala Asp Ser Gly Ser Ser Glu Val Lys Glu Leu Thr Val Tyr Val
35 40 45

Asp Glu Gly Tyr Lys Ser Tyr Ile Glu Glu Val Ala Lys Ala Tyr Glu
50 55 60

Lys Glu Ala Gly Val Lys Val Thr Leu Lys Thr Gly Asp Ala Leu Gly
65 70 75 80

Gly Leu Asp Lys Leu Ser Leu Asp Asn Gln Ser Gly Asn Val Pro Asp
85 90 95

Val Met Met Ala Pro Tyr Asp Arg Val Gly Ser Leu Gly Ser Asp Gly
100 105 110

Gln Leu Ser Glu Val Lys Leu Ser Asp Gly Ala Lys Thr Asp Asp Thr
115 120 125

Thr Lys Ser Leu Val Thr Ala Ala Asn Gly Lys Val Tyr Gly Ala Pro
130 135 140

Ala Val Ile Glu Ser Leu Val Met Tyr Tyr Asn Lys Asp Leu Val Lys
145 150 155 160

Asp Ala Pro Lys Thr Phe Ala Asp Leu Glu Asn Leu Ala Lys Asp Ser
165 170 175

Lys Tyr Ala Phe Ala Gly Glu Asp Gly Lys Thr Thr Ala Phe Leu Ala
180 185 190

Asp Trp Thr Asn Phe Tyr Tyr Thr Tyr Gly Leu Leu Ala Gly Asn Gly
195 200 205

Ala Tyr Val Phe Gly Gln Asn Gly Lys Asp Ala Lys Asp Ile Gly Leu
210 215 220

Ala Asn Asp Gly Ser Ile Val Gly Ile Asn Tyr Ala Lys Ser Trp Tyr
225 230 235 240

Glu Lys Trp Pro Lys Gly Met Gln Asp Thr Glu Gly Ala Gly Asn Leu
245 250 255

Ile Gln Thr Gln Phe Gln Glu Gly Lys Thr Ala Ala Ile Ile Asp Gly
260 265 270

Pro Trp Lys Ala Gln Ala Phe Lys Asp Ala Lys Val Asn Tyr Gly Val
275 280 285

Ala Thr Ile Pro Thr Leu Pro Asn Gly Lys Glu Tyr Ala Ala Phe Gly
290 295 300

Gly Gly Lys Ala Trp Val Ile Pro Gln Ala Val Lys Asn Leu Glu Ala
305 310 315 320

Ser Gln Lys Phe Val Asp Phe Leu Val Ala Thr Glu Gln Gln Lys Val
325 330 335

Leu Tyr Asp Lys Thr Asn Glu Ile Pro Ala Asn Thr Glu Ala Arg Ser
340 345 350

Tyr Ala Glu Gly Lys Asn Asp Glu Leu Thr Thr Ala Val Ile Lys Gln
355 360 365

Phe Lys Asn Thr Gln Pro Leu Pro Asn Ile Ser Gln Met Ser Ala Val
370 375 380

Trp Asp Pro Ala Lys Asn Met Leu Phe Asp Ala Val Ser Gly Gln Lys
385 390 395 400

Asp Ala Lys Thr Ala Ala Asn Asp Ala Val Thr Leu Ile Lys Glu Thr
405 410 415

Ile Lys Gln Lys Phe Gly Glu
420

<210> 734
<211> 335
<212> PRT
<213> Streptococcus pneumoniae

<400> 734

Met Thr Glu Lys Leu Ile Asn Ser Lys Pro Asn Gly Val Phe Ala Leu
1 5 10 15

Ile Leu Ile Glu Leu Thr Ile Val Leu Gly Ile Phe Ile Phe Ile Met
20 25 30

Gly Val Gly Ser Glu Asn Ile Phe Gly Ile Ile Ile Gly Pro Leu Leu
35 40 45

Ile Val Ile Ala Gly Leu Ala His Ala Gly Leu Lys Val Val Lys Pro
50 55 60

Gln Glu Ala Leu Val Leu Thr Leu Phe Gly Asn Tyr Thr Gly Thr Ile
65 70 75 80

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Lys Glu Pro Gly Phe Tyr Phe Val Asn Pro Phe Ser Val Ala Val Asn
                85                  90                  95

Pro Ala Asn His Thr Arg Leu Gly Gln Ser Gly Asp Val Ser Thr Lys
            100                 105                 110

Ser Pro Phe Leu Gly Ala Lys Ser Ser Asn Asp Asn Asp Val Asn Leu
        115                 120                 125

Glu Ile Gly Lys Lys Gln Ile Ser Leu Lys Val Met Thr Leu Ser Asn
    130                 135                 140

Ser Arg Gln Lys Ile Asn Asp Cys Leu Gly Asn Pro Val Glu Ile Gly
145                 150                 155                 160

Ile Ala Val Thr Trp Arg Val Val Asp Thr Ala Lys Ala Val Phe Asn
                165                 170                 175

Val Asp Asn Tyr Lys Glu Tyr Leu Ser Leu Gln Cys Asp Ser Ala Leu
            180                 185                 190

Arg Asn Ile Val Arg Ile Tyr Pro Tyr Asp Val Ser Pro Asn Val Asp
        195                 200                 205

Thr Thr Gly Asp Gly Gln Ala Asp Glu Gly Ser Leu Arg Gly Ser Ser
    210                 215                 220

Glu Ile Val Ala Asn Arg Ile Arg Glu Glu Ile Gln Ser Arg Val Glu
225                 230                 235                 240

Asp Ala Gly Leu Glu Ile Leu Glu Ala Arg Ile Thr Tyr Leu Ala Tyr
                245                 250                 255

Ala Pro Glu Ile Ala Ala Val Met Leu Gln Arg Gln Gln Ala Ser Ala
            260                 265                 270

Ile Ile Asp Ala Arg Lys Met Ile Val Asp Gly Ala Val Gly Met Val
        275                 280                 285

Glu Met Ala Leu Glu Arg Leu Asn Glu Gly Glu Leu Val Glu Leu Asp
    290                 295                 300
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Glu Glu Arg Lys Ala Ala Met Val Ser Asn Leu Leu Val Val Leu Cys
305 310 315 320

Gly Asn His Asp Ala Gln Pro Ile Val Asn Thr Gly Ser Leu Tyr
325 330 335

<210> 735
<211> 338
<212> PRT
<213> Streptococcus pneumoniae

<400> 735

Met Thr Asn Ser Val Phe Gln Gly Arg Ser Phe Leu Ala Glu Lys Asp
1 5 10 15

Phe Thr Arg Ala Glu Leu Glu Tyr Leu Ile Gly Leu Ser Ala His Leu
20 25 30

Lys Asp Leu Lys Lys Arg Asn Ile Gln His His Tyr Leu Ala Gly Lys
35 40 45

Asn Ile Ala Leu Leu Phe Glu Lys Thr Ser Thr Arg Thr Arg Ala Ala
50 55 60

Phe Thr Thr Ala Ala Ile Asp Leu Gly Ala His Pro Glu Tyr Leu Gly
65 70 75 80

Ala Asn Asp Ile Gln Leu Gly Lys Lys Glu Ser Thr Glu Asp Thr Ala
85 90 95

Lys Val Leu Gly Arg Met Phe Asp Gly Ile Glu Phe Arg Gly Phe Ser
100 105 110

Gln Arg Met Val Glu Glu Leu Ala Glu Phe Ser Gly Val Pro Val Trp
115 120 125

Asn Gly Leu Thr Asp Glu Trp His Pro Thr Gln Met Leu Ala Asp Tyr
130 135 140

Leu Thr Val Gln Glu Asn Phe Gly Arg Leu Glu Gly Leu Thr Leu Val
145 150 155 160

Tyr Cys Gly Asp Gly Arg Asn Asn Val Ala Asn Ser Leu Leu Val Thr
165 170 175

Gly Ala Ile Leu Gly Val Asn Val His Ile Phe Ser Pro Lys Glu Leu
180 185 190

Phe Pro Glu Lys Glu Ile Val Glu Leu Ala Glu Gly Phe Ala Lys Glu
195 200 205

Ser Gly Ala His Val Leu Ile Thr Glu Asp Ala Asp Glu Ala Val Lys
210 215 220

Asp Ala Asp Val Leu Tyr Thr Asp Val Trp Val Ser Met Gly Glu Glu
225 230 235 240

Asp Lys Phe Ala Glu Arg Val Ala Leu Leu Lys Pro Tyr Gln Val Asn
245 250 255

Met Asp Leu Val Lys Lys Ala Gly Asn Glu Asn Leu Ile Phe Leu His
260 265 270

Cys Leu Pro Ala Phe His Asp Thr His Thr Val Tyr Gly Lys Asp Val
275 280 285

Ala Glu Lys Phe Gly Val Glu Glu Met Glu Val Thr Asp Glu Val Phe
290 295 300

Arg Ser Lys Tyr Ala Arg His Phe Asp Gln Ala Glu Asn Arg Met His
305 310 315 320

Thr Ile Lys Ala Val Met Ala Ala Thr Leu Gly Asn Leu Tyr Ile Pro
325 330 335

Lys Val

<210> 736
<211> 299
<212> PRT
<213> Streptococcus pneumoniae

<400> 736

Met Ala Ile Phe Phe Met Ile Phe Leu Ile Val Cys Val Leu Leu Leu
1   5   10   15

Val Ile Val Thr Leu Ser Thr Val Tyr Val Val Arg Gln Gln Ser Val
            20   25   30

Ala Ile Ile Glu Arg Phe Gly Lys Tyr Gln Lys Val Ala Asn Ser Gly
        35   40   45

Ile His Ile Arg Leu Pro Phe Gly Ile Asp Ser Ile Ala Ala Arg Ile
    50   55   60

Gln Leu Arg Leu Leu Gln Ser Asp Ile Val Val Glu Thr Lys Thr Lys
65   70   75   80

Asp Asn Val Phe Val Met Met Asn Val Ala Thr Gln Tyr Arg Val Asn
                85   90   95

Glu Gln Ser Val Thr Asp Ala Tyr Tyr Lys Leu Ile Arg Pro Glu Ser
            100   105   110

Gln Ile Lys Ser Tyr Ile Glu Asp Ala Leu Arg Ser Ser Val Pro Lys
        115   120   125

Leu Thr Leu Asp Glu Leu Phe Glu Lys Lys Asp Glu Ile Ala Leu Glu
    130   135   140

Val Gln His Gln Val Ala Glu Glu Met Thr Thr Tyr Gly Tyr Ile Ile
145   150   155   160

Val Lys Thr Leu Ile Thr Lys Val Glu Pro Asp Ala Glu Val Lys Gln
                165   170   175

Ser Met Asn Glu Ile Asn Ala Ala Gln Arg Lys Arg Val Ala Ala Gln
            180   185   190

Glu Leu Ala Glu Ala Asp Lys Ile Lys Ile Val Thr Ala Ala Glu Ala
        195   200   205

Glu Ala Glu Lys Asp Arg Leu His Gly Val Gly Ile Ala Gln Gln Arg

```
    210                 215                 220

Lys Ala Ile Val Asp Gly Leu Ala Glu Ser Ile Thr Glu Leu Lys Glu
225                 230                 235                 240

Ala Asn Val Gly Met Thr Glu Glu Gln Ile Met Ser Ile Leu Leu Thr
                245                 250                 255

Asn Gln Tyr Leu Asp Thr Leu Asn Thr Phe Ala Ser Lys Gly Asn Gln
            260                 265                 270

Thr Ile Phe Leu Pro Asn Thr Pro Asn Gly Val Asp Asp Ile Arg Thr
        275                 280                 285

Gln Ile Leu Ser Ala Leu Arg Ala Glu Lys Lys
    290                 295

&lt;210&gt;  737
&lt;211&gt;  173
&lt;212&gt;  PRT
&lt;213&gt;  Streptococcus pneumoniae

&lt;400&gt;  737

Met Arg Lys Phe Arg Tyr Asn Ser Gln Thr Arg Ser Arg Phe Lys Glu
1               5                   10                  15

Arg Gly Gly Phe Val Met Arg Phe Lys Asn Thr Ser Asp His Ile Glu
            20                  25                  30

Ala Tyr Ile Lys Ala Ile Leu Asp Gln Ser Gly Ile Val Glu Leu Gln
        35                  40                  45

Arg Ser Gln Leu Ala Asp Thr Phe Gln Val Val Pro Ser Gln Ile Asn
    50                  55                  60

Tyr Val Ile Lys Thr Arg Phe Thr Glu Ser Arg Gly Tyr Leu Val Glu
65                  70                  75                  80

Ser Lys Arg Gly Gly Gly Gly Tyr Ile Arg Ile Gly Arg Ile Glu Phe
                85                  90                  95

Ser Ser His His Glu Met Leu Arg Glu Leu Leu Tyr Ser Ile Gly Glu
```

100 105 110

Arg Val Ser Gln Glu Ile Tyr Glu Asp Ile Leu Gln Leu Leu Val Glu
115 120 125

Gln Glu Leu Met Thr Lys Gln Glu Met Asn Leu Leu Glu Ser Val Ala
130 135 140

Leu Asp Arg Val Leu Gly Glu Glu Ala Pro Val Val Arg Ala Asn Met
145 150 155 160

Leu Arg Gln Ile Ile Gln Glu Val Asp Arg Lys Gly Lys
165 170

<210> 738
<211> 150
<212> PRT
<213> Streptococcus pneumoniae

<400> 738

Met Lys Val Ile Phe Leu Ala Asp Val Lys Gly Lys Gly Lys Lys Gly
1 5 10 15

Glu Ile Lys Glu Val Pro Thr Gly Tyr Ala Gln Asn Phe Leu Ile Lys
20 25 30

Lys Asn Leu Ala Lys Glu Ala Thr Ala Gln Ala Val Gly Glu Leu Arg
35 40 45

Gly Lys Gln Lys Ser Glu Glu Lys Ala His Ala Glu Met Ile Ala Glu
50 55 60

Gly Lys Ala Ile Lys Ala Gln Leu Glu Ala Glu Glu Thr Val Val Glu
65 70 75 80

Phe Val Glu Lys Val Gly Pro Asp Gly Arg Thr Phe Gly Ser Ile Thr
85 90 95

Asn Lys Lys Ile Ala Glu Glu Leu Gln Lys Gln Phe Gly Ile Lys Ile
100 105 110

Asp Lys Arg His Ile Gln Val Gln Ala Pro Ile Arg Ala Val Gly Leu

115 120 125

Ile Asp Val Pro Val Lys Ile Tyr Gln Asp Ile Thr Ser Val Ile Asn
130 135 140

Leu Arg Val Lys Glu Gly
145 150

<210> 739
<211> 182
<212> PRT
<213> Streptococcus pneumoniae

<400> 739

Met Ile Lys Tyr Ser Ile Arg Gly Glu Asn Leu Glu Val Thr Glu Ala
1 5 10 15

Ile Arg Asp Tyr Val Val Ser Lys Leu Glu Lys Ile Glu Lys Tyr Phe
20 25 30

Gln Pro Glu Gln Glu Leu Asp Ala Arg Ile Asn Leu Lys Val Tyr Arg
35 40 45

Glu Lys Thr Ala Lys Val Glu Val Thr Ile Pro Leu Gly Ser Ile Thr
50 55 60

Leu Arg Ala Glu Asp Val Ser Gln Asp Met Tyr Gly Ser Ile Asp Leu
65 70 75 80

Val Thr Asp Lys Ile Glu Arg Gln Ile Arg Lys Asn Lys Thr Lys Ile
85 90 95

Glu Arg Lys Asn Lys Asn Lys Val Ala Thr Gly Gln Leu Phe Thr Asp
100 105 110

Ala Leu Val Glu Asp Ser Asn Ile Val Gln Ser Lys Val Val Arg Ser
115 120 125

Lys Gln Ile Asp Leu Lys Pro Met Asp Leu Glu Glu Ala Ile Leu Gln
130 135 140

Met Asp Leu Leu Gly His Asp Phe Phe Ile Tyr Val Asp Val Glu Asp

145 150 155 160

Gln Thr Thr Asn Val Ile Tyr Arg Arg Glu Asp Gly Glu Ile Gly Leu
165 170 175

Leu Glu Val Lys Glu Ser
180

<210> 740
<211> 346
<212> PRT
<213> Streptococcus pneumoniae

<400> 740

Met Ala Glu Ile Thr Ala Lys Leu Val Lys Glu Leu Arg Glu Lys Ser
1 5 10 15

Gly Ala Gly Val Met Asp Ala Lys Lys Ala Leu Val Glu Thr Asp Gly
20 25 30

Asp Ile Glu Lys Ala Ile Glu Leu Leu Arg Glu Lys Gly Met Ala Lys
35 40 45

Ala Ala Lys Lys Ala Asp Arg Val Ala Ala Glu Gly Leu Thr Gly Val
50 55 60

Tyr Val Asn Gly Asn Val Ala Ala Val Ile Glu Val Asn Ala Glu Thr
65 70 75 80

Asp Phe Val Ala Lys Asn Ala Gln Phe Val Glu Leu Val Asn Thr Thr
85 90 95

Ala Lys Val Ile Ala Glu Gly Lys Pro Ala Asn Asn Glu Glu Ala Leu
100 105 110

Ala Leu Ile Met Pro Ser Gly Glu Thr Leu Glu Ala Ala Tyr Val Ser
115 120 125

Ala Thr Ala Thr Ile Gly Glu Lys Ile Ser Phe Arg Arg Phe Ala Leu
130 135 140

Ile Glu Lys Thr Asp Ala Gln His Phe Gly Ala Tyr Gln His Asn Gly

145 150 155 160

Gly Arg Ile Gly Val Ile Ser Val Val Glu Gly Gly Asp Glu Ala Leu
165 170 175

Ala Lys Gln Leu Ser Met His Ile Ala Ala Met Lys Pro Thr Val Leu
180 185 190

Ser Tyr Lys Glu Leu Asp Glu Gln Phe Val Lys Asp Glu Leu Ala Gln
195 200 205

Leu Asn His Val Ile Asp Gln Asp Asn Glu Ser Arg Ala Met Val Asn
210 215 220

Lys Pro Ala Leu Pro His Leu Lys Tyr Gly Ser Lys Ala Gln Leu Thr
225 230 235 240

Asp Asp Val Ile Ala Gln Ala Glu Ala Asp Ile Lys Ala Glu Leu Ala
245 250 255

Ala Glu Gly Lys Pro Glu Lys Ile Trp Asp Lys Ile Ile Pro Gly Lys
260 265 270

Met Asp Arg Phe Met Leu Asp Asn Thr Lys Val Asp Gln Ala Tyr Thr
275 280 285

Leu Leu Ala Gln Val Tyr Ile Met Asp Asp Ser Lys Thr Val Glu Ala
290 295 300

Tyr Leu Glu Ser Val Asn Ala Ser Val Val Glu Phe Ala Arg Phe Glu
305 310 315 320

Val Gly Glu Gly Ile Glu Lys Ala Ala Asn Asp Phe Glu Ala Glu Val
325 330 335

Ala Ala Thr Met Ala Ala Ala Leu Asn Asn
340 345

<210> 741
<211> 286
<212> PRT
<213> Streptococcus pneumoniae

<400> 741

```
Met Asn Cys Glu Ala Val Ala Leu Gly Ser Phe Cys Glu Leu Lys Ser
1               5                   10                  15

Arg Arg Gly Lys Lys Gln Lys Gly Glu Ile Leu Met Ala Val Ile Ser
            20                  25                  30

Met Lys Gln Leu Leu Glu Ala Gly Val His Phe Gly His Gln Thr Arg
        35                  40                  45

Arg Trp Asn Pro Lys Met Ala Lys Tyr Ile Phe Thr Glu Arg Asn Gly
    50                  55                  60

Ile His Val Ile Asp Leu Gln Gln Thr Val Lys Tyr Ala Asp Gln Ala
65                  70                  75                  80

Tyr Asp Phe Met Arg Asp Ala Ala Ala Asn Asp Ala Val Val Leu Phe
                85                  90                  95

Val Gly Thr Lys Lys Gln Ala Ala Asp Ala Val Ala Glu Glu Ala Val
            100                 105                 110

Arg Ser Gly Gln Tyr Phe Ile Asn His Arg Trp Leu Gly Gly Thr Leu
        115                 120                 125

Thr Asn Trp Gly Thr Ile Gln Lys Arg Ile Ala Arg Leu Lys Glu Ile
    130                 135                 140

Lys Arg Met Glu Glu Asp Gly Thr Phe Glu Val Leu Pro Lys Lys Glu
145                 150                 155                 160

Val Ala Leu Leu Asn Lys Gln Arg Ala Arg Leu Glu Lys Phe Leu Gly
                165                 170                 175

Gly Ile Glu Asp Met Pro Arg Ile Pro Asp Val Met Tyr Val Val Asp
            180                 185                 190

Pro His Lys Glu Gln Ile Ala Val Lys Glu Ala Lys Lys Leu Gly Ile
        195                 200                 205
```

Pro Val Val Ala Met Val Asp Thr Asn Thr Asp Pro Asp Asp Ile Asp
    210   215   220

Val Ile Ile Pro Ala Asn Asp Asp Ala Ile Arg Ala Val Lys Leu Ile
225   230   235   240

Thr Ala Lys Leu Ala Asp Ala Ile Ile Glu Gly Arg Gln Gly Glu Asp
                245   250   255

Ala Val Ala Val Glu Ala Glu Phe Ala Ala Leu Glu Thr Gln Ala Asp
            260   265   270

Ser Ile Glu Glu Ile Val Glu Val Val Glu Gly Asp Asn Ala
        275   280   285

<210> 742
<211> 272
<212> PRT
<213> Streptococcus pneumoniae

<400> 742

Met Asn Arg Phe Lys Lys Ser Lys Tyr Val Ile Ile Val Phe Val Thr
1   5   10   15

Val Leu Leu Val Ser Ala Leu Leu Ala Thr Thr Tyr Ser Ser Thr Ile
            20   25   30

Val Thr Lys Leu Gly Asp Gly Ile Ser Leu Val Asp Arg Val Val Gln
        35   40   45

Lys Pro Phe Gln Trp Phe Asp Ser Val Lys Ser Asp Leu Ala His Leu
    50   55   60

Thr Arg Thr Tyr Asn Glu Asn Glu Ser Leu Lys Lys Gln Leu Tyr Gln
65   70   75   80

Leu Glu Val Lys Ser Asn Glu Val Glu Ser Leu Lys Thr Glu Asn Glu
                85   90   95

Gln Leu Arg Gln Leu Leu Asp Met Lys Ser Lys Leu Gln Ala Thr Lys
            100   105   110

```
Thr Leu Ala Ala Asp Val Ile Met Arg Ser Pro Val Ser Trp Lys Gln
        115                 120                 125

Glu Leu Thr Leu Asp Ala Gly Arg Ser Lys Gly Ala Ser Glu Asn Met
    130                 135                 140

Leu Ala Ile Ala Asn Gly Gly Leu Ile Gly Ser Val Ser Lys Val Glu
145                 150                 155                 160

Glu Asn Ser Thr Ile Val Asn Leu Leu Thr Asn Thr Glu Asn Ala Asp
                165                 170                 175

Lys Ile Ser Val Lys Ile Gln His Gly Ser Thr Thr Ile Tyr Gly Ile
            180                 185                 190

Ile Ile Gly Tyr Asp Lys Glu Asn Asp Val Leu Lys Ile Ser Gln Leu
        195                 200                 205

Asn Ser Asn Ser Asp Ile Ser Ala Gly Asp Lys Val Thr Thr Gly Gly
    210                 215                 220

Leu Gly Asn Phe Asn Val Ala Asp Ile Pro Val Gly Glu Val Val Ala
225                 230                 235                 240

Thr Thr His Ser Thr Asp Tyr Leu Thr Arg Glu Val Thr Val Lys Leu
                245                 250                 255

Ser Ala Asp Thr His Asn Val Asp Val Ile Glu Leu Val Gly Asn Ser
            260                 265                 270

<210>  743
<211>  275
<212>  PRT
<213>  Streptococcus pneumoniae

<400>  743

Met Lys Ser Ile Ile Asp Val Lys Asn Leu Ser Phe Arg Tyr Lys Glu
1               5                   10                  15

Asn Gln Asn Tyr Tyr Asp Val Lys Asp Ile Thr Phe His Val Lys Arg
            20                  25                  30
```

```
Gly Glu Trp Leu Ser Ile Val Gly His Asn Gly Ser Gly Lys Ser Thr
        35                  40                  45

Thr Val Arg Leu Ile Asp Gly Leu Leu Glu Ala Glu Ser Gly Glu Ile
    50                  55                  60

Val Ile Asp Gly Gln Arg Leu Thr Glu Glu Asn Val Trp Asn Ile Arg
65                  70                  75                  80

Arg Gln Ile Gly Met Val Phe Gln Asn Pro Asp Asn Gln Phe Val Gly
                85                  90                  95

Ala Thr Val Glu Asp Asp Val Ala Phe Gly Leu Glu Asn Gln Gly Leu
            100                 105                 110

Ser Arg Gln Glu Met Lys Lys Arg Val Glu Glu Ala Leu Ala Leu Val
        115                 120                 125

Gly Met Leu Asp Phe Lys Lys Arg Glu Pro Ala Arg Leu Ser Gly Gly
    130                 135                 140

Gln Lys Gln Arg Val Ala Ile Ala Gly Val Val Ala Leu Arg Pro Ala
145                 150                 155                 160

Ile Leu Ile Leu Asp Glu Ala Thr Ser Met Leu Asp Pro Glu Gly Arg
                165                 170                 175

Arg Glu Leu Ile Gly Thr Val Lys Gly Ile Arg Lys Asp Tyr Asp Met
            180                 185                 190

Thr Val Ile Ser Ile Thr His Asp Leu Glu Glu Val Ala Met Ser Asp
        195                 200                 205

Arg Val Leu Val Met Lys Lys Gly Glu Ile Glu Ser Thr Ser Ser Pro
    210                 215                 220

Arg Glu Leu Phe Ser Arg Asn Asp Leu Asp Gln Ile Gly Leu Asp Asp
225                 230                 235                 240

Pro Phe Ala Asn Gln Leu Lys Lys Ser Leu Ser Gln Asn Gly Tyr Asp
                245                 250                 255
```

Leu Pro Glu Asn Tyr Leu Thr Glu Ser Glu Leu Glu Asp Lys Leu Trp
260 265 270

Glu Leu Leu
275

<210> 744
<211> 276
<212> PRT
<213> Streptococcus pneumoniae

<400> 744

Met Thr Ser Met Arg Lys Lys Thr Ile Gly Glu Val Leu Arg Leu Ala
1 5 10 15

Arg Ile Asn Gln Gly Leu Ser Leu Asp Glu Leu Gln Lys Lys Thr Glu
20 25 30

Ile Gln Leu Asp Met Leu Glu Ala Met Glu Ala Asp Asp Phe Asp Gln
35 40 45

Leu Pro Ser Pro Phe Tyr Thr Arg Ser Phe Leu Lys Lys Tyr Ala Trp
50 55 60

Ala Val Glu Leu Asp Asp Gln Ile Val Leu Asp Ala Tyr Asp Ser Gly
65 70 75 80

Ser Met Ile Thr Tyr Glu Glu Val Asp Val Asp Glu Asp Glu Leu Thr
85 90 95

Gly Arg Arg Arg Ser Ser Lys Lys Lys Lys Lys Lys Thr Ser Phe Leu
100 105 110

Pro Leu Phe Tyr Phe Ile Leu Phe Ala Leu Ser Ile Leu Ile Phe Val
115 120 125

Thr Tyr Tyr Val Trp Asn Tyr Ile Gln Thr Gln Pro Glu Glu Pro Ser
130 135 140

Leu Ser Asn Tyr Ser Val Val Gln Ser Thr Ser Ser Thr Ser Ser Val
145 150 155 160

Pro His Ser Ser Ser Ser Ser Ser Ser Ser Ile Glu Ser Ala Ile Ser
165 170 175

Val Ser Gly Glu Gly Asn His Val Glu Ile Ala Tyr Lys Thr Ser Lys
180 185 190

Glu Thr Val Lys Leu Gln Leu Ala Val Ser Asp Val Thr Ser Trp Val
195 200 205

Ser Val Ser Glu Ser Glu Leu Glu Gly Gly Val Thr Leu Ser Pro Lys
210 215 220

Lys Lys Ser Ala Glu Ala Thr Val Ala Thr Lys Ser Pro Val Thr Ile
225 230 235 240

Thr Leu Gly Val Val Lys Gly Val Asp Leu Thr Val Asp Asn Gln Thr
245 250 255

Val Asp Leu Ser Lys Leu Thr Ala Gln Thr Gly Gln Ile Thr Val Thr
260 265 270

Phe Thr Lys Asn
275

<210> 745
<211> 339
<212> PRT
<213> Streptococcus pneumoniae

<400> 745

Met Glu Asn Leu Val Lys Ser Thr Ser Tyr Thr Tyr Ile Pro Glu Glu
1 5 10 15

Ile Met Ser Phe Ser Asp Leu Lys Leu Phe Ala Leu Ser Ser Asn Lys
20 25 30

Glu Leu Ala Glu Arg Val Ala Gln Glu Ile Gly Ile Glu Leu Gly Lys
35 40 45

Ser Ser Val Arg Gln Phe Ser Asp Gly Glu Ile Gln Val Asn Ile Glu
50 55 60

```
Glu Ser Ile Arg Gly Lys His Val Phe Ile Leu Gln Ser Thr Ser Ser
65                  70                  75                  80

Pro Val Asn Asp Asn Leu Leu Glu Ile Leu Ile Met Val Asp Ala Leu
                85                  90                  95

Lys Arg Ala Ser Ala Glu Ser Val Asn Val Val Met Pro Tyr Tyr Gly
            100                 105                 110

Tyr Ala Arg Gln Asp Arg Lys Ala Arg Ala Arg Glu Pro Ile Thr Ser
        115                 120                 125

Lys Leu Val Ala Asn Met Leu Glu Val Ala Gly Val Asp Arg Leu Leu
    130                 135                 140

Thr Ile Asp Leu His Ala Ala Gln Ile Gln Gly Phe Phe Asp Ile Pro
145                 150                 155                 160

Val Asp His Leu Met Gly Ala Pro Leu Ile Ala Asp Tyr Phe Glu Arg
                165                 170                 175

Arg Gly Met Val Gly Ser Asp Tyr Val Val Val Ser Pro Asp His Gly
            180                 185                 190

Gly Val Thr Arg Ala Arg Lys Leu Ala Glu Phe Leu Lys Thr Ser Ile
        195                 200                 205

Ala Ile Ile Asp Lys Arg Arg Ser Val Asp Lys Met Asn Thr Ser Glu
    210                 215                 220

Val Met Asn Ile Ile Gly Lys Val Glu Gly Lys Thr Cys Ile Leu Ile
225                 230                 235                 240

Asp Asp Met Ile Asp Thr Ala Gly Thr Ile Cys His Ala Ala Asp Ala
                245                 250                 255

Leu Ala Glu Ala Gly Ala Val Glu Val Tyr Ala Ser Cys Thr His Pro
            260                 265                 270

Val Leu Ser Gly Pro Ala Thr Asp Asn Ile Gln Lys Ser Ala Ile Lys
        275                 280                 285
```

Lys Leu Val Val Leu Asp Thr Ile Tyr Leu Pro Glu Glu Arg Leu Ile
290 295 300

Asp Lys Ile Glu Gln Ile Ser Ile Ala His Leu Leu Gly Asp Ala Ile
305 310 315 320

Val Arg Ile His Glu Lys Arg Pro Leu Ser Pro Leu Phe Asp Ile Glu
325 330 335

Lys Lys Ile

<210> 746
<211> 220
<212> PRT
<213> Streptococcus pneumoniae

<400> 746

Met Asp Leu Thr Lys Arg Phe Asn Lys Gln Leu Asp Lys Ile Gln Val
1 5 10 15

Ser Leu Ile Arg Gln Phe Asp Gln Ala Ile Ser Glu Ile Pro Gly Val
20 25 30

Leu Arg Leu Thr Leu Gly Glu Pro Asp Phe Thr Thr Pro Asp His Val
35 40 45

Lys Glu Ala Gly Lys Arg Ala Ile Asp Gln Asn Gln Ser Tyr Tyr Thr
50 55 60

Gly Met Ser Gly Leu Leu Thr Leu Arg Gln Ala Ala Ser Asp Phe Val
65 70 75 80

Lys Glu Lys Tyr Gln Leu Asp Tyr Ala Pro Glu Asn Glu Ile Leu Val
85 90 95

Thr Ile Gly Ala Thr Glu Ala Leu Ser Ala Thr Leu Thr Ala Ile Leu
100 105 110

Glu Glu Gly Asp Lys Val Leu Leu Pro Ala Pro Ala Tyr Pro Gly Tyr
115 120 125

Glu Pro Ile Val Asn Leu Val Gly Ala Glu Ile Val Glu Ile Asp Thr
    130   135   140

Thr Glu Asn Gly Phe Val Leu Thr Pro Glu Met Leu Glu Lys Ala Ile
145   150   155   160

Leu Glu Gln Gly Asp Lys Leu Lys Ala Val Ile Leu Asn Tyr Pro Ala
                165   170   175

Asn Pro Thr Gly Ile Thr Tyr Ser Arg Glu Gln Leu Glu Ala Leu Ala
            180   185   190

Ala Val Leu Arg Lys Tyr Glu Ile Phe Val Val Cys Asp Glu Val Tyr
        195   200   205

Ser Glu Leu Thr Tyr Thr Gly Glu Ala Met Cys Leu
    210   215   220

<210> 747
<211> 432
<212> PRT
<213> Streptococcus pneumoniae

<400> 747

Met Ile Asn Arg Tyr Ser Arg Pro Glu Met Ala Asn Ile Trp Ser Glu
1   5   10   15

Glu Asn Lys Tyr Arg Ala Trp Leu Glu Val Glu Ile Leu Ser Asp Glu
            20   25   30

Ala Trp Ala Glu Leu Gly Glu Ile Pro Lys Glu Asp Val Ala Leu Ile
        35   40   45

Arg Lys Lys Ala Asp Phe Asp Ile Asp Arg Ile Leu Glu Ile Glu Gln
    50   55   60

Glu Thr Arg His Asp Val Val Ala Phe Thr Arg Ala Val Ser Glu Thr
65   70   75   80

Leu Gly Glu Glu Arg Lys Trp Val His Tyr Gly Leu Thr Ser Thr Asp
                85   90   95

```
Val Val Asp Thr Ala Tyr Gly Tyr Leu Tyr Lys Gln Ala Asn Asp Ile
            100                 105                 110

Ile Arg Arg Asp Leu Glu Asn Phe Thr Asn Ile Ile Ala Asp Lys Ala
        115                 120                 125

Lys Glu His Lys Phe Thr Ile Met Met Gly Arg Thr His Gly Val His
    130                 135                 140

Ala Glu Pro Thr Thr Phe Gly Leu Lys Leu Ala Thr Trp Tyr Ser Glu
145                 150                 155                 160

Met Lys Arg Asn Ile Glu Arg Phe Glu His Ala Ala Ala Gly Val Glu
                165                 170                 175

Ala Gly Lys Ile Ser Gly Ala Val Gly Asn Phe Ala Asn Ile Pro Pro
            180                 185                 190

Phe Val Glu Glu Tyr Val Cys Asp Lys Leu Gly Ile Arg Ala Gln Glu
        195                 200                 205

Ile Ser Thr Gln Val Leu Pro Arg Asp Leu His Ala Glu Tyr Phe Ala
    210                 215                 220

Val Leu Ala Ser Ile Ala Thr Ser Ile Glu Arg Met Ala Thr Glu Ile
225                 230                 235                 240

Arg Gly Leu Gln Lys Ser Glu Gln Arg Glu Val Glu Glu Phe Phe Ala
                245                 250                 255

Lys Gly Gln Lys Gly Ser Ser Ala Met Pro His Lys Arg Asn Pro Ile
            260                 265                 270

Gly Ser Glu Asn Met Thr Gly Leu Ala Arg Val Ile Arg Gly His Met
        275                 280                 285

Ile Thr Ala Tyr Glu Asn Val Ala Leu Trp His Glu Arg Asp Ile Ser
    290                 295                 300

His Ser Ser Ala Glu Arg Ile Ile Thr Pro Asp Thr Thr Ile Leu Ile
```

305 310 315 320

Asp Tyr Met Leu Asn Arg Phe Gly Asn Ile Val Lys Asn Leu Thr Val
325 330 335

Phe Pro Glu Asn Met Ile Arg Asn Met Asn Ser Thr Phe Gly Leu Ile
340 345 350

Phe Ser Gln Arg Ala Met Leu Thr Leu Ile Glu Lys Gly Met Thr Arg
355 360 365

Glu Gln Ala Tyr Asp Leu Val Gln Pro Lys Thr Ala Tyr Ser Trp Asp
370 375 380

Asn Gln Val Asp Phe Lys Pro Leu Leu Glu Ala Asp Ser Glu Val Thr
385 390 395 400

Ser Arg Leu Thr Gln Glu Glu Ile Asp Glu Ile Phe Asn Pro Val Tyr
405 410 415

Tyr Thr Lys Arg Val Asp Asp Ile Phe Glu Arg Leu Gly Leu Gly Asp
420 425 430

<210> 748
<211> 301
<212> PRT
<213> Streptococcus pneumoniae

<400> 748

Met Ile Gln Trp Trp Gln Ile Leu Leu Leu Thr Leu Tyr Ser Ala Tyr
1 5 10 15

Gln Ile Cys Asp Glu Leu Thr Ile Val Ser Ser Ala Gly Ser Pro Val
20 25 30

Phe Ala Gly Phe Ile Thr Gly Leu Ile Met Gly Asp Val Thr Thr Gly
35 40 45

Leu Leu Ile Gly Gly Asn Leu Gln Leu Phe Val Leu Gly Val Gly Thr
50 55 60

Phe Gly Gly Ala Ser Arg Ile Asp Ala Thr Ser Gly Ala Val Leu Ala

65 70 75 80

Thr Ala Phe Ser Val Ser Gln Gly Ile Asp Ala Pro Leu Ala Ile Thr
85 90 95

Thr Ile Ala Val Pro Val Ala Ala Leu Leu Thr Tyr Phe Asp Val Leu
100 105 110

Gly Arg Met Thr Thr Thr Phe Phe Ala His Arg Val Asp Ala Ala Ile
115 120 125

Glu Arg Phe Asp Tyr Lys Gly Ile Glu Arg Asn Tyr Leu Leu Gly Ala
130 135 140

Ile Pro Trp Ala Leu Ser Arg Ala Leu Pro Val Phe Phe Ala Leu Ala
145 150 155 160

Phe Gly Gly Ala Phe Val Gln Ser Val Val Asp Phe Val Glu Ala Tyr
165 170 175

Lys Trp Val Ala Asp Gly Leu Thr Leu Ala Gly Arg Met Leu Pro Gly
180 185 190

Leu Gly Phe Ala Ile Leu Leu Arg Tyr Leu Pro Val Lys Arg Asn Leu
195 200 205

His Tyr Leu Ala Met Gly Phe Gly Leu Thr Ala Met Leu Thr Val Leu
210 215 220

Tyr Ser Tyr Val Thr Gly Leu Gly Gly Ala Val Ala Gly Ile Val Gly
225 230 235 240

Thr Leu Pro Ala Glu Val Ala Glu Lys Ile Gly Phe Val Asn Asn Phe
245 250 255

Lys Gly Leu Ser Met Ile Gly Ile Ser Ile Val Gly Ile Phe Leu Ala
260 265 270

Val Leu His Phe Lys Asn Ser Gln Lys Val Ala Val Ala Ala Pro Ser
275 280 285

Thr Pro Ser Glu Ser Gly Glu Ile Glu Asp Asp Glu Phe
290 295 300

<210> 749
<211> 276
<212> PRT
<213> Streptococcus pneumoniae

<400> 749

Met Gly Lys Ser Lys Met Thr Asn Ser Asn Tyr Lys Leu Thr Lys Glu
1 5 10 15

Asp Phe Asn Gln Ile Asn Lys Arg Ser Leu Phe Thr Phe Gln Leu Gly
20 25 30

Trp Asn Tyr Glu Arg Met Gln Ala Ser Gly Tyr Leu Tyr Met Ile Leu
35 40 45

Pro Gln Leu Arg Lys Met Tyr Gly Asp Gly Thr Pro Glu Leu Lys Glu
50 55 60

Met Met Lys Val His Thr Gln Phe Phe Asn Thr Ser Pro Phe Phe His
65 70 75 80

Thr Ile Ile Ala Gly Phe Asp Leu Ala Met Glu Glu Lys Asp Gly Val
85 90 95

Gly Ser Lys Asp Ala Val Asn Gly Ile Lys Thr Gly Leu Met Gly Pro
100 105 110

Phe Ala Pro Leu Gly Asp Thr Ile Phe Gly Ser Leu Val Pro Ala Ile
115 120 125

Met Gly Ser Val Ala Ala Thr Met Ala Ile Ala Gly Gln Pro Trp Gly
130 135 140

Ile Phe Leu Trp Ile Ala Val Ala Val Ala Tyr Asp Ile Phe Arg Trp
145 150 155 160

Lys Gln Leu Glu Phe Ala Tyr Lys Glu Gly Val Asn Leu Ile Asn Asn
165 170 175

Met Gln Ser Thr Leu Thr Ala Leu Ile Asp Ala Ala Ser Val Leu Gly
180 185 190

Val Phe Met Met Gly Ala Leu Val Ala Thr Val Ile Asn Phe Glu Ile
195 200 205

Ser Tyr Lys Leu Pro Ile Gly Glu Lys Met Ile Asp Phe Gln Asp Ile
210 215 220

Leu Asn Gln Ile Phe Pro Arg Leu Leu Pro Ala Ile Phe Thr Ala Phe
225 230 235 240

Ile Phe Trp Leu Leu Gly Lys Lys Gly Met Asn Ser Thr Lys Ala Ile
245 250 255

Gly Ile Ile Ile Val Leu Ala Leu Ala Leu Ser Ala Leu Gly His Phe
260 265 270

Ala Leu Gly Met
275

<210> 750
<211> 388
<212> PRT
<213> Streptococcus pneumoniae

<400> 750

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20 25 30

Glu Phe Tyr Gln Ala Lys Arg Glu Glu Ile Ala Ala Phe Leu Gln Glu
35 40 45

Ile Ala Asp Lys His Asp Tyr Ile Lys Val Ile Leu Thr Gly Ala Gly
50 55 60

Thr Ser Ala Tyr Val Gly Asp Thr Leu Leu Pro Tyr Phe Lys Glu Val
65 70 75 80

Tyr Asp Glu Arg Lys Trp Asn Phe Asn Ala Ile Ala Thr Thr Asp Ile
                85   90   95

Val Ala Asn Pro Ala Thr Tyr Leu Lys Lys Asp Val Ala Thr Val Leu
            100   105   110

Val Ser Phe Ala Arg Ser Gly Asn Ser Pro Glu Ser Leu Ala Thr Val
        115   120   125

Asp Leu Ala Lys Ser Leu Val Asp Glu Leu Tyr Gln Val Thr Ile Thr
    130   135   140

Cys Ala Ala Asp Gly Lys Leu Ala Leu Gln Ala His Gly Asp Asp Arg
145   150   155   160

Asn Leu Leu Leu Leu Gln Pro Ala Val Ser Asn Asp Ala Gly Phe Ala
                165   170   175

Met Thr Ser Ser Phe Thr Ser Met Met Leu Thr Thr Leu Leu Val Phe
            180   185   190

Asp Pro Thr Glu Phe Ala Val Lys Ser Glu Arg Phe Glu Val Val Ser
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Ser Leu Ala Arg Lys Val Leu Asp Lys Ala Glu Asp Val Lys Glu Leu
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Val Asp Leu Asp Phe Asn Arg Val Ile Tyr Leu Gly Ala Gly Pro Phe
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Phe Gly Leu Ala His Glu Ala Gln Leu Lys Ile Leu Glu Leu Thr Ala
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            260   265   270

Pro Lys Ser Leu Ile Asn Asp Asn Thr Val Val Leu Val Phe Gly Thr
        275   280   285

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<213> Streptococcus pneumoniae

<400> 751

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35 40 45

Leu Gln Leu Ala Glu Lys Gln Lys Leu Arg Phe Thr Tyr Gly Val Gly
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Glu Lys Gln Phe Arg Asn Leu Phe Val Gln Ala Thr Lys Ile Lys Gly
65 70 75 80

Gly Ile Leu Gly Phe Asn Phe Met Leu Leu Leu Glu Arg Arg Leu Asp
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Asn Val Val Tyr Arg Leu Gly Leu Ala Thr Thr Arg Arg Gln Ala Arg
100 105 110

Gln Phe Val Asn His Gly His Ile Leu Val Asp Gly Lys Arg Val Asp
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Ile Pro Ser Tyr Arg Val Thr Pro Gly Gln Val Ile Ser Val Arg Glu
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Lys Ser Leu Lys Val Pro Ala Ile Leu Glu Ala Val Glu Ala Thr Leu
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Gly Arg Pro Ala Phe Val Ser Phe Asp Ala Glu Lys Leu Glu Gly Ser
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<210> 752
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<212> PRT
<213> Streptococcus pneumoniae

<400> 752

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Ile Gly Leu Lys Gly Arg Ile Leu Val Ala Asp Glu Gly Ile Asn Gly
35 40 45

Thr Val Ser Gly Asp Tyr Glu Thr Thr Gln Lys Tyr Met Asp Tyr Val
50 55 60

His Ser Leu Pro Gly Met Glu Glu Leu Trp Phe Lys Ile Asp Glu Glu
65 70 75 80

Asn Glu Gln Ala Phe Lys Lys Met Phe Val Arg Tyr Lys Lys Glu Ile
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Val His Leu Gly Leu Glu Asp Asn Asp Phe Asp Asn Asp Ile Asn Pro
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Leu Leu Asp Lys Asp Thr Val Val Leu Asp Thr Arg Asn Asp Tyr Glu
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Tyr Asp Leu Gly His Phe Arg Gly Ala Ile Arg Pro Asp Ile Arg Asn
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165 170 175

Asp Lys Arg Val Val Val Tyr Cys Thr Gly Gly Val Arg Cys Glu Lys
180 185 190

Phe Ser Gly Trp Met Val Arg Glu Gly Tyr Lys Asp Val Gly Gln Leu
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His Gly Gly Ile Ala Thr Tyr Gly Lys Asp Pro Glu Val Gln Gly Glu
210 215 220

Leu Trp Asp Gly Lys Met Tyr Val Phe Asp Glu Arg Ile Ala Val Asp
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Val Asn His Val Asn Pro Thr Ile Val Gly Lys Asp Trp Phe Asp Gly
245 250 255

Thr Pro Cys Glu Arg Tyr Val Asn Cys Gly Asn Pro Phe Cys Asn Arg
260 265 270

Arg Ile Leu Thr Ser Glu Glu Asn Glu Asp Lys Tyr Leu Arg Gly Cys
275 280 285

Ser His Glu Cys Arg Val His Pro Arg Asn Arg Tyr Val Ser Lys Asn
290 295 300

Glu Leu Thr Gln Ala Glu Val Ile Glu Arg Leu Ala Ala Ile Gly Glu
305 310 315 320

Ser Leu Asp Gln Ala Ala Thr Val
325

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Published:
- *with international search report*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report: 15 December 2005

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 2002/083855 A3

(54) Title: NOVEL STREPTOCOCCUS PNEUMONIAE OPEN READING FRAMES ENCODING POLYPEPTIDE ANTIGENS AND USES THEREOF

(57) Abstract: The present invention relates to newly identified open reading frames comprised within the genomic nucleotide sequence of *Streptococcus pneumoniae*, wherein the open reading frames encode polypeptides that are surface localized on *Streptococcus pneumoniae*. Thus, the invention relates to *Streptococcus pneumoniae* open reading frames that encode polypeptide antigens, polypeptides, preferably antigenic polypeptides, encoded by the *Streptococcus pneumoniae* open reading frames, vectors comprising open reading frame sequences and cells or animals transformed with these vectors. The invention relates also to methods of detecting these nucleic acids or polypeptides and kits for diagnosing *Streptococcus pneumoniae* infection. The invention finally relates to pharmaceutical compositions, in particular immunogenic compositions, for the prevention and/or treatment of bacterial infection, in particular infections with *Streptococcus pneumoniae*. In particular embodiments, the immunogenic compositions are used for the treatment or prevention of systemic diseases which are induced or exacerbated by *Streptococcus pneumoniae*. In other embodiments, the immunogenic compositions are used for the treatment or prevention of non-systemic diseases, particularly of the otitis media, which are induced or exacerbated by *Streptococcus pneumoniae*.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US02/11524

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : C12N 15/00, 9/16, 1/20; C12Q 1/68 ,1/30; C07H 21/04; C12P 19/34

US CL : 435/320.1,172.3,196, 252.3, 69.7, 6, 5, 91.2 ; 530/350; 536/23.7, 23.4, 29.3, 24.32, 24.33

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 435/320.1,172.3,196, 252.3, 69.7, 6, 5, 91.2 ; 530/350; 536/23.7, 23.4, 29.3, 24.32, 24.33

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Continuation Sheet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6,420,135 B1 (KUNSCH et al) 16 July 2002 (16.07.2002), especially abstract, claims and ORF1, 2 and 3	1-24, 59-67, 80-85, 90, 99-102 and 105 in part
X	US 6,887,663 B1 (CHOI et al) 03 May 2005 (05.03.2005), especially abstract, claims, examples and sequence number 56.	1-24, 59-67, 80-85, 90, 99-102 and 105 in part

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 August 2005 (08.08.2005)	02 NOV 2005

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US

Commissioner of Patents

P.O. Box 1450

Alexandria, Virginia 22313-1450

Facsimile No. 571-273-8300

Authorized officer

Padmavathi v. Baskar

Janice Ford for

Telephone No. 571-272-1600

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US02/11524

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claim Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claim Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
Please See Continuation Sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: Claims 1-24, 59-67, 80-85, 90, 99-102 and 105 in part

Remark on Protest ☐ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

PCT/US02/11524

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING

1. This application contains the following inventions or groups of inventions, which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, Claims 1-24, 59-67, 80-85, 90, 99-102 and 105 in part drawn to isolated polynucleotide, recombinant expression vector, host cell, an immunogenic composition DNA chip, a kit and a method of producing protein.
Further restriction to one SEQ.ID.NO required (see paragraph # 4).
Group II, Claims 25-58, 72-79, 86-89, 91 in part are drawn to an isolated polypeptide, immunogenic composition, pharmaceutical composition and a polypeptide chip.
Further restriction to one SEQ.ID.NO required (see paragraph # 4).
Group III Claims 68-71, and 103-104 in part drawn to an antibody and a kit.
Further restriction to one SEQ.ID.NO required (see paragraph # 4).
Group IV Claims 92-94 in part drawn to a method for of immunizing against
S. pneumoniae.
Further restriction to one SEQ.ID.NO required (see paragraph # 4).
Groups V Claim 95 in part drawn to a method for detecting and identification of
S. pneumoniae using hybridization.
Further restriction to one SEQ.ID.NO required (see paragraph # 4).
Group VI Claim 96 in part drawn to a method for detecting and identification of
S. pneumoniae using PCR
Further restriction to one SEQ.ID.NO required (see paragraph # 4).
Group VII Claim 97-98 in part drawn to a method for detecting and identification of
S. pneumoniae by immuno assay i.e., detection of immune complex.
Further restriction to one SEQ.ID.NO required (see paragraph # 4).

The inventions listed as Groups 1-7 (in Part) do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

2. The technical feature of linking Groups I-VII appears to be that they all relate to polynucleotide, polypeptide and antibody.
The technical feature of linking groups appears to be that they are all related to peptides, nucleic acids and antibodies and methods of using peptides, nucleic acids and antibodies.
However, Kunsch et al US-PAT-NO: 6420135 disclose an isolated polynucleotide sequence comprising a fragment sequence SEQ.ID.NO: 3 or 46 or 38 (see claims) and thus read on group I. Therefore, the technical feature of linking groups I-VII does not constitute a special technical feature as defined by PCT Rule 13.2, as it does not define a contribution over the prior art and hence unity of invention is lacking.

The special technical feature of Group I is considered to be polynucleotide, which is made up of nucleic acids.

The special technical feature of Group II considered to be polypeptide that shares no common structure, property and function with Group I since peptides contain amino acids and do not share the same or a corresponding technical feature with Group I nucleic acids

The special technical feature of Group III considered to be antibody that shares no common structure, property and function from Inventions I-375 and 376-350 since it has an inherent affinity, avidity, and specificity that DNA or a simple protein is not capable of expressing and do not require each other for their practice.

PCT/US02/11524

INTERNATIONAL SEARCH REPORT

The technical feature linking groups IV-VII is considered to be methods utilizing products that share no common structure, property and function so as to form a single general inventive concept under Rule 13.1. Hence, unity is lacking among groups.

3. Pursuant to 37 C.F.R.$ 1.475 (d), the ISA/US considers that where multiple products, processes and methods are claimed, the main invention shall consists of the first invention of the category first mentioned in the claims and the first recited invention of each of the other categories related thereto. Accordingly the main invention For Example: (Group 1) comprises Claims 1-24, 59-67, 80-85, 90, 99-102 and 105 in part drawn to an isolated polynucleotide, SEQ.ID.NO: 1, recombinant expression vector, host cell, an immunogenic composition, DNA chip, a kit and a method for producing the protein which is the first product and first method.

Further pursuant to 37 C.F.R.$ 1.475 (d), the ISA/US considers that any feature which the subsequently recited products and methods share with the main invention does not constitute a special technical feature within the meaning of PCT Rule 13.2 and that each of such products and methods accordingly defines a separate invention. Therefore, the groups of inventions below do not constitute a special technical feature within the meaning of PCT Rule 13.2 and that each of such products and methods accordingly defines a separate invention.

4. For each group of inventions I-VII above, restriction to one of the following SEQ.ID.NO is also required under PCT Rule 13.1 because, under PCT Rule 13.2. Therefore, election is required of one of inventions I-VII and one of SEQ.ID.NO: 1-215 and 431-591.
Inventions SEQ.ID.NO: 1-215 and 431-591 are not so linked as to under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:
The claimed polypeptides and polynucleotides (i.e., SEQ.ID.NO I-215-431-591) share no common special technical feature because the polynucleotides and peptides have no common structure (i.e., no common sequence) as evidenced by their sequences SEQ.ID.NO I-215-431-591. These sequences that share no common structure as polynucleotides and polypeptides and are not linked by the same the same or a corresponding special technical feature so as to form a single general inventive concept. Therefore, where structural identity is required, such as for hybridization or expression of protein or binding of antibody, each sequence appears perform a different function in that peptides elicit an antibody response and nucleic acids encode peptides that specifically bind to an antibody. Thus they share no common structure and function so as to form a single general inventive concept under Rule 13.1. Hence, unity is lacking among groups SEQ.ID.NOS.
Applicant is required under PCT Rule 13.1 because, under PCT Rule 13.2 to elect a single disclosed SEQ.ID.NO from any group elected.

Continuation of B. FIELDS SEARCHED Item 3:
MEDLINE, STN, A -GENSEQ, N-GENSEQ, EST, DERWENT, SWISS-PROT, PIR, USPTOWEST, SWISSSPTREMBL, GENEMBEL, PUBLISHED APPLICATIONS AND ISSUED PATENTS, search terms: Streptococcus, pneumoniae, open reading frames, peptides, nucleic acid, fragment, SEQ.ID.NO:1, degenerate variant